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Rev. 07/10/02

Versar INC.

May 20, 1999

Michael McAteer	Myron Walters
USEPA, HSRW-6J	IDEM
77 West Jackson Blvd.	100 North Senate Street
Chicago, IL 60604-3590	P.O. Box 6015
	Indianapolis, IN 46206

Re: Enviro-Chem RRA
Operations & Maintenance Manual

Dear Sirs:

Enclosed is a copy of the O&M Manual for the Soil Vapor Extraction and Wasterwater Treatment Systems at the Enviro-Chem Site. As I discussed with Tim Harrison, a complete set of all the referenced vendor manuals, drawings, and previously submitted plans and reports is excluded due to their volume.

I will be happy to provide you with any specific item you request or answer any questions. Please call me at 215-788-7844, extension237, if you need anything.

Very truly yours,

Charles J Gaffney

Charles J. Gaffney,

cc: R. Ball (ENVIRON)
N. Bernstein (NEB & A)
R. Hutchins (ENVIRON)
T. Harrison (CH2MHill)
G. Anastos (Versar)

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OPERATION AND MAINTENANCE MANUAL

SOIL VAPOR EXTRACTION
and
WASTEWATER REMEDIATION SYSTEMS

ENVIROCHEM SUPERFUND PROJECT
985 South State Road 421
Boone County, Zionsville, Indiana 46077

January 1999

Prepared For:

Versar, Inc.
1900 Bristol Road, Suite 110
Bristol, Pennsylvania 19007

Prepared By:

Handex of Indiana, Inc.
8579 Zionsville Road
Indianapolis, Indiana 46268
(317) 228-6240

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SECTION 1

ENGINEER'S ABSTRACT REPORT

This Operation and Maintenance manual is for the soil vapor extraction and wastewater treatment system at the Environmental Conservation and Chemical Corporation (ECC) site in Zionsville, Boone County, Indiana. The design and installation of the system were performed under the oversight of the Environmental Protection Agency (EPA), Indiana Department of Environmental Management, the ECC Trust and Radian International . The property is a 6.5 acre parcel located at 985 South State Road 421 in Boone County immediately west of the Northside Sanitary Landfill (NSL).

ECC began operation in 1977 and was engaged in the recovery/reclamation/brokering of primary solvents, oils and other wastes received from industrial clients. Waste products were received in drums and bulk tankers then prepared for subsequent reclamation or disposal. Reclamation processes included distillation, evaporation and fractionation to reclaim solvents and oil.

Accumulation of contaminated stormwater onsite, poor management of the drum inventory and several spill incidents caused initial state and EPA investigations that later led to civil suits and finally placement of ECC into receivership in July 1981. Drum shipments to the site were halted in February 1982. The company was found insolvent in August 1982, and the state and EPA began plans for cleanup. Numerous site investigations, including sampling and analysis, were conducted during the period.

Removal measures at the site began in March 1983 and continued through 1984. Actions included the removal and treatment or disposal of cooling pond waters, approximately 30,000 drums of waste, 220,000 gallons of hazardous waste from tanks and 5,650 cubic yards of contaminated soil and cooling pond sludge. A clay cover was placed over the exclusion zone in 1986 as an interim remedial measure.

A Remedial Investigation/Feasibility Study (RI/FS) was conducted by CH2M Hill for the U.S. EPA from 1983 through 1986. The Record of Decision (ROD) for the Site was issued on September 25, 1987 and amended on June 7, 1991. The Consent Decree for remediation of the Site was entered on September 10, 1991.

Preliminary site investigations continued through 1997. Radian International completed a 90% design of a wastewater treatment system and initial performance specifications for an insitu soil vapor extraction system. During June 1997 the ECC Trust solicited requests for proposal from design/construction contractors. Versar and Handex Environmental created a project team to complete the design, construction and operation of the site remediation system.

Versar and Handex were contracted by the ECC Trust to begin the project work in September, 1997. Site mobilization began during December 1997 and site construction activities continued through November 1998.

The site remediation system includes recovery of volatile organics from soil vapors and onsite storage and treatment of impacted water. This manual provides an overview of the site wastewater treatment operator's (OPERATOR) responsibility and describes the functions and operation of each individual piece of equipment, with critical sections incorporating the operation of the overall system together and the interaction of each component.

<u>Soil Vapor Extraction System</u>

Insitu soil vapor extraction was chosen as the main remedial technology. Based on pilot testing completed by Terra Vac during May and June 1988, Versar/Handex designed vapor extraction trenches for the recovery of volatile organics. All SVE trenches run on an east-west configuration with a lateral spacing of approximately 30 feet. High permeability concrete aggregate and coarse angular stone fills each of the trenches with slotted well screen installed within the upper two feet of the trench for removal of vapors.

The SVE system is segregated into a "native" soil component and a "fill area" component. The native soil area includes the Northern and Central SVE area with 58 SVE trenches installed through the native material. The soil which was excavated from the Southern site area has been landfilled atop the Northern SVE area. The northern fill area includes 26 SVE trenches installed through the landfill soils from the southern area.

Extraction piping from the 84 SVE trenches has been paired to minimize the size of the extraction header. In this way the 58 SVE trenches of the native soil are manifolded into 29 individual extraction lines within the treatment building. Similarly, the 26 northern fill trenches have been manifolded into 13 extraction lines within the treatment building.

SVE Equipment

All SVE and wastewater treatment equipment are housed within the treatment building. Vacuum is created by two (2) 60 horsepower rotary lobe blowers. All extracted soil vapors enter the treatment building through the 42 extraction pipes at a common header. Influent vapor condensate is removed from the extracted vapors within the K-1 knock-out tank.

After vapors exit the K-1 tank, they enter the blower and exhaust together into a common 12-inch effluent line. SVE exhaust is cooled within an air-to-water heat exchanger (HX-1) with remaining condensate removed within a second knock-out tank (K-2).

After equalization and cooling, the SVE vapors are routed together with the air stripper off-gas to vapor phase carbon off-gas treatment units. During the initial phase of the project, two (2) 13,600 pound vapor phase GAC skids will be used for vapor treatment. After the influent SVE levels stabilized, the large vapor skids will be removed. The off-gas system during long-term operation uses four (4) 3,000 pound vapor canisters installed in two identical treatment trains of two units per train.

Native Soil Dewatering System

Site investigations have identified fluctuations of shallow water beneath the site through the SVE remediation zone (surface to 9 feet below grade). In order to maintain shallow water levels beneath the zone of remediation, dewatering piping was installed within the bottom of each of the SVE trenches.

Six pneumatic double diaphragm pumps are used to dewater the SVE trenches. The operator must manually balance the suction control valves from each of the 21 influent dewatering lines. The individual pneumatic pumps are controlled by the PLC system and vacuum switches. If no water is available to pump, the dewatering pumps cannot create a vacuum and the vacuum switches open signaling the PLC to stop the pumps for a pre-determined period of time.

Recovered wastewater is pumped into a 500-gallon common equalization tank (S-1). A surface mounted transfer pump (P-2) transfers water from S-1 to the 150,000-gallon aeration tank T-2, prior to onsite water treatment.

T-2 Influent Aeration Tank

The operation of the SVE recovery and treatment system has been designed for an automatic unmanned 24 hour per day operation. As per the project specifications, operation of the wastewater treatment system must occur under the supervision of an Indiana licensed wastewater treatment operator. Because of the limitation in wastewater treatment, two steel bolt-together, lined 150,000-gallon tanks have been constructed at the site to store water to be processed.

The T-2 influent tank is distinquished from the T-4 effluent tank by a plastic cover. Under normal conditions, a clean air compressor provides air to diffusers within the bottom of T-2. The constant air flow to the inside of T-2 provides an air bubble that lifts the T-2 cover. Trapped air beneath the T-2 cover is routed through two (2) 180-pound vapor phase GAC units before discharge to the atmosphere.

T-2 provides accumulation of recovered water during periods when the operator is not onsite. Five point level control floats have been installed within T-2. Specific attention is paid to the High #1 level control float that notifies the operator when T-2 reached 65% of capacity. At this time the operator will respond to the site conditions and treat the influent water through the onsite treatment equipment.

T-2 also provides a source of cooling water for the HX-1; air-to-water heat exchanger. The P-7 pump draws water constantly from T-2, screens the water, pumps it through the heat exchanger and discharges the "warmed" water to the S-1 tank. The P-2 pump draws water from S-1 and returns it to the T-2 tank.

Bag Filtration

The initial treatment of stored water from T-2 is through two bag filtration units. The influent transfer pumps P-100A and P-100B, located within the treatment building, draw water from the bottom of T-2. Through the controls of the PLC, the OPERATOR will start the treatment system. Once the air stripping blower reaches anticipated speed and air flow, one of the P-100 pumps will begin transfering water from the T-2 tank through the initial bag filter units and into the air stripping tower.

The operator manually adjusts influent flow rate after the TSS filters, but prior to the air stripper. In this way the full available head of the influent pumps is placed on the influent filter socks to decrease the chances of flow decline due to filter backpressure.

Air Stripping System

The tray air stripping system provides primary treatment of volatile organics. Influent is fed directly from the P-100 pumps, through the influent TSS filters and into the influent spray nozzle of the air stripper. The stripper includes 4 aeration trays, integral effluent equalization sump, an influent air blower, and site glass with level control probes. Also included on the air stripper is an air pressure gauge, low air pressure switch and influent air flow monitor.

The stripper normally runs automatically with a minimal time delay in the start of the air stripper blower before the P-100 pumps. An increase in air backpressure is an indication of plugging of the stripper trays and the need for stripper cleaning.

GAC Units, Liquid

Air stripper effluent collects within the air stripper sump. When the sump level reaches a pre-determined level, the PLC begins operation of the GAC influent pumps; P-1A and P-1B. The GAC pumps transfer air stripper effluent through a second pair of TSS filters, through the dual GAC units and directly to the T-4 effluent tank.

Volatile organics which remain after the air stripper will be removed using the dual granular activated carbon units. Each unit is identical with the system currently piped with the GAC units piped in series. Each GAC unit is sized for a normal flow rate of 35 gallons per minute.

Each GAC unit has been installed with pressure gauges, flow control valves, vacuum breakers, pressure relief valves and sample ports on the influent and effluent legs of the units.

Programmable Logic Controller

The Programmable Logic Control (PLC) panel controls the operations of the recovery and treatment systems. The panel controls the motor starters for the various pumps and equipment, a 24 volt DC power supply for the various field instruments, the PLC components and racks, a front mounted Man Machine Interface (MMI) plus barrier strips for all field connections.

The PLC is pre-programmed to monitor the condition of all instruments and control the operation of all motors. The PLC itself is divided into two different types of units: input monitoring and output control. By monitoring individual instrument points (e.g., Tank 2 Level) the PLC can be programmed to provide control for multiple motors (e.g. Tank 2 Level controls the operation P-100, P-2, P-7 and P-300). The system complexity is only limited by the programmer's abilities and the number of I/O points; therefore, the operator must be familiar with the entire system operation and interaction of the components.

All system operations are controlled through the PLC, requiring the operator to become very familiar with the system logic and operation of the various components. This manual is limited in scope and provides little background information regarding electrical safety and electrical hazards. The operator should limit his interface with the PLC to the Panel Mate screen on the outside of the panel. The controller interior includes a variety of voltages (115 volt, 24 vDC, 12 vDC, 5 vDC, etc.) and system components (fuses, breakers, terminal strips, jumpers, etc.).

T-4 Effluent Equalization Tank

As per the project specifications, operation of the water treatment system must occur under the supervision of an Indiana licensed wastewater treatment operator. Because of the limitation in wastewater treatment, two steel bolt-together, lined 150,000 gallon tanks have been constructed at the site to store influent and effluent water.

The T-4 effluent tank is closer to the treatment building than the T-2 tank and does not have a tank cover. Under normal conditions, the T-4 tank will remain nearly empty. All system effluent will normally be routed from the treatment system to the T-4 tank for storage prior to discharge.

NOTICE:

This Operations and Maintenance Manual is being prepared as a record of the system design, normal system operation and an overview of the system components. This manual is not designed as a training manual and should only be used by a trained licensed wastewater treatment operator to compliment previous training and work experience.
No system adjustments should be made without reviewing the original system design and performance specifications. Similarly, only a licensed electrician should make any electrical adjustments or modifications to the system

SECTION 2

EMERGENCY SHUT DOWN PROCEDURES

2.1 General

The site remediation system has been designed to be a self-monitoring system. Under normal conditions, the system will continue to recover, store, treat and discharge both soil vapors and water at a constant rate. Should a routine "alarm" condition occur, all upstream flow processes would cease while the downstream flow processes will continue until the alarm condition is reset. For a listing of "routine alarm" conditions, please see Section 18.0 Initial and Alarm Site Conditions.

2.2 Emergency Shut Down Procedures

Please note that while operating, the system includes both stored and "in-process" flow streams. Shut down of either the SVE system or the water treatment system without following the proper Shut down Procedures may result in flooding of a treatment unit, flooding of the treatment building and/or personal injury. Under all conditions the treatment building MUST BE CONSIDERED A DANGEROUS ENVIRONMENT, AN INDUSTRIAL FACILITY and NO UNAUTHORIZED PERSONNEL shall be allowed access.

Should the operator choose to cease system operation in an emergency, the following procedures should be undertaken. CAUTION MUST BE TAKEN, SOME OF THESE SHUT DOWN PROCEDURES ARE FOR EMERGENCY MEASURES ONLY, HOWEVER THE EVALUATION AND INSPECTION PROCEDURES SHOULD BE FOLLOWED WHENEVER ANY SHUT DOWN IS TO OCCUR.

2.2.1 Level 1 Emergency Shut Down Procedure- Highest Personal Safety

A Level 1 Emergency shut down may occur when the operator or responding personnel is concerned with his/her personal safety. A Level 1 shut down should only be used whenever the system is inaccessible, but a shut down is inevitable.

Level 1 Shut down of both systems- Problem unknown.

1. All electrical service to the systems is provided by an underground electrical service which is mounted on the western end of the treatment building, beneath the building canopy. Opening the locked motor starter disconnects within the motor control center (MCC) on the outside of the building and turning the circuit breakers off will cease all power to the individual motor systems.

2. After ceasing the electrical service to the systems, pressurized airlines may provide a threat to personnel safety. All compressed air supply line valves within the air compressor building should be closed and the manual drain valve on the bottom of the air compressor receiver should be opened and the stored air should be drained.

3. After ceasing the electrical service to the systems, pressurized water lines may also provide a threat to personnel safety. The pressures on individual flow lines for each of the pumps should be inspected. If the flow line pressures are above 5 psi, the operator may manually drain the influent and effluent lines using the various sampling or priming valves in the pump flow lines.

4. After shutting the system down, the control panel and all components should be properly tagged and locked out following all OSHA procedures.

2.2.2 Level 2 Emergency Shut Down Procedure- Moderate Personal Safety

A Level 2 Emergency shut down may be conducted by only a trained system operator. A Level 2 shut down should be used when the system is partially accessible and the operator is trained to conduct such a shut down. If the operator has any doubts regarding his training and experience, he/she should follow a Level 1 shut down procedure and contact the appropriate personnel.

1. Whenever in doubt, contact HANDEX at (317) 228-6240.

2. Inspect the exterior of the T-2 and T-4 tanks from the inspection walkway. If the water within the tanks is high proceed with caution and consider a Level 1 shut down. If levels appear OK, proceed to next step.

3. Inspect the compressor building from outside for leaks or fluid on the floor. If dry and clean proceed to next step. If the floor is wet or includes standing water, do not attempt to contact any electrical panels or components.

4. Inspect treatment building from outside for leaks or fluid on the floor. If dry and clean, proceed to next step. If the floor is wet or includes standing water, do not attempt to contact any electrical panels or components

5. Access the PanelView MMI screen and observe the system status. If a specific motor function is in question, proceed to the next step. If the system appears normal continue observing the system from the building exterior for a minimum of 5 minutes.

6. Inspect the electrical disconnects within each "can" of the MCC. Record the status of all circuit breakers. If a breaker is tripped, do not reset but continue on the system inspection.

7. If the building is safe and secure, continue the shut down procedure starting from the influent side of the SVE system.

   a) (IF operating) Turn off the Air Injection Pump (AP-1) at the Panel View MMI
   b) Turn off the H-O-A switch for Vapor Pump #1 at the Panel View MMI
   c) Turn off the H-O-A switch for Vapor Pump #2 at the Panel View MMI
   d) Turn off the 6 individual air solenoid valves for the double diaphragm dewatering pumps at the Panel View MMI
   e) Turn off the P-7 Heat Exchanger pump at the Panel View MMI
   f) Turn off the P-1 K-1 drain pump at the Panel View MMI
   g) Turn off the P-2 S-1 Equalization pump at the Panel View MMI

8. At this point, all SVE treatment units and process pumps should be off. The water treatment system may still be operating depending upon the initial system status. The operator should follow the following shut down order to cease the operation of the water system.

   a) Turn off both of the P-100 air stripper influent pumps at the Panel View MMI
   b) Wait 3 minutes for the air stripper to continue to drain.
   c) Turn off the P-1 GAC feed pumps at the Panel View MMI
   d) Turn off the P-300 recirculation pump at the Panel View MMI
   e) Turn off the P-200 final system discharge pump at the Panel View MMI
   f) Turn off the air solenoid for the floor sump pump at the Panel View MMI

9. All Panel View control switches should be shut OFF at this point. THE OPERATOR SHOULD NOTE VERY LOW ENERGY ELECTRICAL POWER STILL REMAINS TO THE VARIOUS LEVEL CONTROL PROBES and PRESSURE TRANSDUCERS INSTRUMENTS.

10. The operaror must evaluate the reason for system shut down to continue further. The **only** remaining control functions to the building are FID off-gas vapor monitor pump, HVAC, receptacles and lighting.

11. The operator must log the date and time of the shut down, the reason for the shut down and the operator' s signature.

12. After shut down of the recovery and treatment systems, the operator must check to confirm normal building functions are still in tact. Specifically, the operator should not cease function of any of the following systems:
    - Building Lights and Convenience Receptacles
    - Building Heater

AS A FINAL NOTE, THE OPERATOR SHOULD FOLLOW THESE SHUT DOWN PROCEDURES WHENEVER THE SYSTEM OPERATION IS CEASED.

THE OPERATOR MUST ALSO BE AWARE OF ALL ELECTRICAL LOCK-OUT/TAG-OUT REQUIREMENTS DURING MAINTENANCE OR LONG TERM SHUT DOWN FOR EQUIPMENT FAILURE.

WHENEVER IN DOUBT AND EMERGENCY SHUT DOWN IS REQUIRED THE OPERATOR SHOULD SHUT THE SYSTEM DOWN AT THE EMERGENCY OFF BUTTON ON THE FRONT OF THE PANEL OR THE MAIN MOTOR DISCONNECTS.

END OF SECTION

SECTION 3

HEALTH AND SAFETY

3.1 Health and Safety Plan

Any work involved with the remediation of the Enviro-Chem site shall be conducted under the jurisdiction of the Occupational Health and Safety Administration (OSHA). The maintenance and monitoring contractor for the site must maintain an acceptable Health and Safety Plan which accurately defines the physical and chemical hazards of the site, potential escape routes, proper personal protective equipment and emergency contacts.

The water and soil beneath the site has been tested to determine the chemical and physical characteristics of the various compounds of concern. This information has been used to evaluate the environmental health and safety hazards for the site. Although this manual is not meant as a Health and Safety Plan, anyone working near or around the treatment system shall be familiar with the following details regarding the site characteristics:

1. Water and soil samples have identified various chlorinated volatile organic compounds and non-chlorinated volatile organics including known and suspected carcinogens.

2. The original design engineer has classified the building as a Class 1 Division 1, Group D environment as defined within the National Electrical Code. The OPERATOR must be aware of spark or flash hazards and the consequences of such hazards.

3. The Enviro-Chem facility has been abandoned. Often times the system operator may be onsite alone. The operator must constantly use personal judgement when completing work alone to assure personal safety.

The site specific Health and Safety Plan (HASP) shall be consulted prior to any work activities at the site. This Operations and Maintenance Manual is designed to complement the knowledge of a trained environmental technician. It is not intended as a training manual. Only a trained professional who has read the site specific HASP in compliance with OSHA 1910.120 and is familiar with each piece of equipment will be allowed to inspect, start or stop the system or make any system adjustments. Only a licensed electrician should make any electrical adjustments or repairs. Under all conditions the treatment building should be considered an Industrial Facility and NO UNAUTHORIZED PERSONNEL should be allowed access.

Workers new to the site must contact the Versar Project Manager, 215-788-7844, and the Handex Project Manager, 317-228-6240, prior to initiating work and provide documentation of OSHA training and written acknowledgment that the site specific HASP was read. A copy of the site HASP is included within Appendix T of this manual, however, the typical HASP must be modified as additional work is completed at the site. All operation and maintenance of the system should be conducted in accordance with OSHA requirements and all other applicable Federal, State and Local requirements.

3.2 Emergency Phone Numbers

The following is a list of emergency contacts for the Enviro-Chem facility as of November 1998. These numbers should be reconfirmed by the operator at a minimum of semi-annually to confirm their accuracy.

Emergency Service	*Telephone Number*
General Emergency Services	*911*
Ambulance	*(317) 873-3363*
Hospital Emergency Room	*(317) 388-2121*
Police/ Sheriff's Office	*(317) 873-2233*
Fire Department	*(317) 873-3344*
HAZMAT Team (local)	*(317) 241-4336*
Poison Information Center	*(800) 762-0727*
U.S. EPA Project Manager; Mike McAteer	*(312) 886-4663*

The nearest emergency service hospital to the project site is currently Saint Vincent Hospital, Indianapolis. Travel time from the site to Saint Vincent Hospital is approximately 20 minutes depending upon traffic.

Directions to the hospital are as follows:

From the site gate, make a left onto Route 421 South.
Travel 8.5 miles on Route 421 South (Note Route 421 becomes North Michigan Road)
Turn left onto West 86th Street after Route 465 overpass
Travel East on West 86th Street 1.4 miles.
Saint Vincent's Hospital in on the right side of West 86th Street.

3.4 Versar Phone Numbers

Versar, Inc completed the recovery and treatment system design. Should questions or problems arise regarding the initial system design, site features or general site concerns, appropriate Versar personnel may be contacted at the following address:

Versar, Inc.	General Phone number	215.788.7844
1900 Frost Road	Fax number	215.788.8680
Suite 110		
Bristol, Pennsylvania 19007		

George Anastos, Ph.D., PE	Remedial Project Manager
Charles Gaffney, P.O.E.	Construction Manager
David A. Basko	Quality Control Manager

3.4 Handex Phone Numbers

The recovery and treatment system was installed and initially operated by Handex of Indiana, Inc. Should questions or problems arise which are outside of the scope of this document, appropriate Handex personnel may be contacted at the following address:

Handex of Indiana, Inc. 8579 Zionsville Road Indianapolis, Indiana 46268	General Phone 317.228.6240 Fax Number 317.228.6243
Greg Scarpone Ray Kassab	Project Manager Class C Wastewater Operator
David C. Puchalski, PE Handex of New Jersey, Inc. 500 Campus Drive Morganville, New Jersey 07751	Design Engineer Phone 732.536.8667 ext 241 Fax 732.536.8804 Pager 800.946.4646 PIN # 610.8950

3.5 Fire Extinguishers

Fire extinguishers have been placed within the treatment building. All fire extinguishers are dry chemical type, suitable for A, B and C type fire. The operator shall inspect the fire extinguishers on a regular basis and contract a firm to refill the units as needed or replace the units.

3.6 Compressed Hydrogen Gas

Compressed hydrogen fuel gas is stored onsite outside of the air compressor building within a separate weatherproof enclosure. The hydrogen gas is used as a fuel source for the flame ionization detector (FID) for the off-gas monitor. The operator should maintain a safe storage distance for any large equipment or materials that may break or impair the fuel feed lines or cylinder regulator.

END OF SECTION

SECTION 4

GENERAL OVERVIEW OF SYSTEM

4.1 Description and Function of the SVE System

The soils remediation system for the Enviro-Chem facility has been designed and installed under the oversight of the US Environmental Protection Agency and the Indiana Department of Environmental Management and a Department of Justice Consent Decree. The mechanical operation of the SVE system has two general remediation zones, with the final intent of removing volatile organic compounds from the site soils. The two general remediation zones are as follows:

1) Remediate the native soils in the Northern and Central fill SVE areas to a depth of 9 feet below initial grade.
2) Remediate the "landfilled" soils which were excavated from the Southern Concrete Pad area.

Recovered soil vapors are removed from these two remediation zones via 42 individual extraction lines. Two vacuum pumps create a vacuum upon the extraction lines normally ranging from 4 to 10-inches of mercury vacuum. All recovered vapors are routed through a primary knock-out tank (K-1) and then into the two parallel vacuum pumps. Extracted vapors are then routed through an air to water heat exchanger to control the temperature of the off-gas vapors and then a secondary knock-out pot (K-2). After instrumentation for vapor flow rate, contaminant load and air temperature, the off-gas vapors are treated within 4-3,000 pound vapor phase carbon units operating in two parallel trains of two units. The final air stream from the carbon units is exhausted to the atmosphere.

4.2 Description and Function of the Dewatering System

Natural water beneath the native SVE area has reportedly fluctuated to levels as high as 6 feet below grade. During these periods of high water, the remediation zone from 6 feet to 9 feet will be masked by water. In order to extend the effectiveness of the SVE system at the lower zones, a water dewatering system has been installed in conjunction with the SVE system in the native areas.

The dewatering system includes a network of 21 individual extraction lines connected to 58 dewatering screens. One dewatering screen has been installed within each of the SVE extraction trenches to an average depth of 8.25 feet below initial grade. The extraction lines are manifolded together into groups of 3 and 4 lines. Each of the manifolded dewatering lines are connected to a surface mounted double diaphrapm dewaterwing pump. The air operated DDP's create a vacuum on the dewatering lines and dewater the SVE trenches.

The operator can manually control the extraction rate from each of the extraction lines by individual ball valves. The system also includes vacuum switches connected to the main suction line of each DDP. During periods of low water, the DDP's will not be able to withdraw water and thus will not create a vacuum. During these periods the vacuum switch will interface with the PLC to shut the air lines to the individual DDP.

Recovered water from the DDP's is pumped to the S-1 equalization tank. Water within S-1 is pumped via the P-2 pump to the T-2 influent tank for aeration and equalization prior to being treated by the wastewater operator .

4.3 Description of the Wastewater Treatment System

Recovered water influent is aerated and equalized within the main influent tank T-2. The main system Programmable Logic Controller (PLC) is integrated with liquid level instrumentation within T-2 and the T-2 leak detection sumps to monitor the system. At a predetermined set point of 65% of total tank capacity, the first high level float (High #1) will signal an alarm condition to the Remote Monitoring Unit (RMU) to notify the system operator.

Each start-up of the water treatment system must be conducted under the supervision of a licensed wastewater treatment operator. After notification of the 65% tank level, the operator will mobilize to the site to begin processing recovered water.

At system start-up, the operator will initially energize the air stripper blower. This will begin the blower operation and clear the air stripper low-pressure-switch alarm. The P-100A and/or P-100B influent feed pumps will then be energized. The PLC will begin the operation of the air stripper blower and 30 seconds later begin transferring water from the T-2 tank using the P-100 pumps.

Raw influent water is filtered through two suspended solids filters. The TSS filters are normally operated in series, but may be operated in parallel to minimize system backpressure. After initial filtration, filtered influent is treated within the countercurrent tray aeration air stripper for primary removal of all volatile organics.

Air stripper effluent drains into an integral equalization sump within the base of the air stripper. Level control floats integrate with the PLC to control the operation of the P-1A and P-1B GAC transfer pumps. Air stripper effluent is filtered of suspended solids through two additional TSS filters and then filtered through two granular activated carbon vessels for removal of residual hydrocarbons.

GAC effluent normally continues from the treatment building to onsite storage and equalization within the T-4 effluent tank. The system effluent is normally sampled prior to being transferred to T-4. Valving and sample ports have also been included to sample before final discharge from the P-200 pump or at the P-300 recirculation pump.

After complete processing or whenever designated treated water from T-4 may be recirculated to the T-2 tank using the P-300 recirculation pump. Likewise, T-4 effluent water may be discharged to the onsite drainage swale and to the surface waters of Indiana by using the P-200 final effluent pump.

The PLC system monitors several functions at the site including air flow rates, liquid levels within the tanks, pump operations and process air quality. The PLC system includes a man-machine interface (Panel View) which allows monitoring of all instrument functions and pump operations. All system operations are controlled through the PLC, therefore requiring the operator to become very familiar with the system logic and operation of the various components. This manual is limited in scope and provides little background information regarding electrical safety and electrical hazards. The operator should limit his interface with the PLC to the Panel View screen and the push-buttons on the outside of the panel. The controller interior includes a variety of voltages (115 volt, 24 vDC, 12 vDC, 5 vDC, etc.) and system components (fuses, breakers, terminal strips, jumpers, etc.).

4.4 Environmental Hazard Warning

The operation, monitoring and maintenance of the recovery and treatment systems shall be conducted under the authority of the Occupational Health and Safety Administration (OSHA). All personnel must be properly trained regarding environmental hazards, and they must be informed of all current and potential hazards and provided the necessary equipment to protect them from environmental exposure. Should the operator have any questions regarding environmental, health and safety hazards, a trained OSHA expert should be consulted and all work should stop immediately.

4.5 IDEM Discharge to Surface Water Approval

Discharge of the treated water is under the approval of the Indiana Department of Environmental Management. The approval is issued under the authority of the Clean Water Enforcement Act with all civil and criminal penalties associated with the Act. A complete copy of the IDEM Discharge Approval is included within Appendix B.

The following is a list of discharge limitations for the treatment system effluent and monitoring requirements:

Parameter	Minimum Sampling	Units	Daily Maximum
Flow Rate	Monthly	MGD	No Limit
pH	Monthly	SU	6.5 to 9.0
<u>Volatile Organics</u>			
Vinyl Chloride	Monthly	ug/l	10
Methylene Chloride	Monthly	ug/l	5
1,1 Dichloroethene	Monthly	ug/l	2
1,2 Dichloroethane	Monthly	ug/l	2
1,1,1 Trichloroethane	Monthly	ug/l	200
Trichloroethene	Monthly	ug/l	10
1,1,2 Trichloroethane	Monthly	ug/l	42
Tetrachloroethene	Monthly	ug/l	5

Parameter	Minimum Sampling	Units	Daily Maximum
Toluene	Monthly	ug/l	480
Ethylbenzene	Monthly	ug/l	700
<u>Semi-Volatile Organics</u>			
Phenol	Monthly	ug/l	570
1,2 Dichlorobenzene	Monthly	ug/l	760
Napthalene	Monthly	ug/l	69
Diethylphthalate	Monthly	ug/l	7,000
Di-n-Butylphthalate	Monthly	ug/l	21
Bis (2-Ethylhexyl) Phthalate	Monthly	ug/l	580

4.6 Air Discharge Approval

Discharge of the treated SVE and air stripper off-gas is under the approval of the Indiana Department of Environmental Management. A complete copy of the IDEM Discharge Approval is included within Appendix B.

The following is the discharge limitations for the SVE off-gas treatment system effluent.

Parameter	Minimum Sampling	Units	Daily Maximum
Flow Rate	Monthly	SCFM	No Limit

END OF SECTION

SECTION 5

SVE Vacuum Pumps

5.1 Description and Function of the System

Remediation of the site soils via soil vapor extraction is the primary goal of the treatment system. The main components of the SVE system are the two vacuum pumps that remove the soil vapors. The vacuum pumps are designed to operate in parallel on any combination of the 42 extraction lines and to run constantly. Once started the vacuum pumps should continue to function with only extra-ordinary circumstances stopping the system. The PLC monitors all instrumentation and controls the operation of the SVE blowers. Typical factors that may cause an automatic SVE shut down include:

- ✓ A high FID reading on the vapor phase GAC #1 Effluent.
- ✓ A high-high level within the building floor sump.
- ✓ A high-high level within the K-1 primary knockout tank.
- ✓ A high-high level within the K-2 secondary knockout tank.

The SVE system has been designed to remove the largest volume of air during the initial phases of the project. As individual extraction trenches reach asymptotic levels extraction from these trenches will be periodically ceased, thereby changing the flow characteristics from the vacuum pumps. A manufacturer Operation and Maintenance manual for the vacuum pumps is included within Appendix C. The following are general specifications for the two vacuum pumps VP-1 and VP-2:

Design Air flow	1,175 cfm / blower
Design Vacuum	10-inches of mercury vacuum
Design Backpressure	1.25-inches of mercury pressure
Design Discharge Temperature	< 175 Degrees F
Motor Classification	NEMA 7, Explosionproof
Motor Size	60 HP
Manufacturers Model No.	RBLP110-V
Manufacturers Machine No.	601249-50
Manufacturer	Spencer Turbine Company 600 Day Hill Road Windsor, Connecticut 06095-4706
Manufacturer Phone No.	800.232.4321 or 860.688.8361

5.2 SVE Extraction Trenches

Site testing and visual observations during the installation of the remediation system indicate the shallow soils beneath the site are heterogeneous. In general the soils include a high silt content with varying amounts of sand and clay across the site. Based on site testing performed by TerraVac, the final SVE system design included several extraction trenches excavated from the native material and backfilled with high permeability materials. The following sections describe the specifications for the native soil trenches as well as the backfilled soil trenches.

5.2.1 Native Soil Vapor Extraction Trenches

The soils beneath the Northern SVE treatment area and the Central SVE treatment area encompass an area of approximately 2.5 acres. The shallow soil from the surface to a depth of 9 feet below grade is the major media of concern. Based upon site testing performed by TerraVac a horizontal radius of influence of 20 feet was estimated from each extraction trench. Based on this information, a pattern of 42 trenches within the Northern SVE area and 16 trenches in the Central SVE area was determined to be optimal.

Each of the SVE trenches was excavated from existing grade to a minimum depth of 8 feet below grade. All trenches were excavated with a 24-inch wide excavator bucket, yielding a minimum trench width of 19-inches. The trenches were installed in geometric pattern running east-west with each trench 40 feet in length. After excavating, the native soil was stockpiled for cover of the SVE trenches. Crushed and sorted gravel fragments from the concrete pad were placed within the backfill of each trench. Clean sorted gravel from an offsite source was also used for approximately two thirds of the project. The use of the high permeability gravel increases the surface area of the induced vacuum on the trenches.

A 1.5-inch dewatering point was installed within the bottom of each of the native trenches. The dewatering points were brought to grade with PVC pipe and interconnected to PVC suction lines. Every three dewatering points were connected to one common dewatering suction line.

Individual two-inch slotted screens were placed in the upper 2 feet of the excavated trench. The vapor extraction screens were transitioned to solid piping and then to 3-inch extraction trunk lines to the treatment building. Two trenches are connected to each of the 3-inch extraction trunk lines.

5.2.2 Backfilled Soil Vapor Extraction Trenches

The soils beneath the Southern Concrete Pad area presented a continuing environmental concern. During site construction, the soils from this area were excavated and placed within a "landfill cell" constructed atop the northern native fill area.

Similar to the northern and central SVE treatment areas, shallow SVE trenches were installed within the southern pad soil cell. Based on the site testing and a conservative design approach, the central SVE trenches were placed on a horizontal spacing of 30 feet with each trench being 50 feet long. After excavating, the excavated soil was stockpiled for cover of the SVE trenches in the cell. Crushed and sorted gravel fragments from the concrete pad were placed within the backfill of each trench.

Individual two-inch slotted screens were placed in the upper 2 feet of the excavated trench. The vapor extraction screens were transitioned to solid piping and then to 3-inch extraction trunk lines to the treatment building. Two trenches are connected to each of the 3-inch extraction trunk lines.

5.3 SVE Influent Header

The 42 three inch SVE trunk lines run from the treatment building to the pairs of SVE trenches in the field. Within the treatment building, the 3-inch trunk lines combine into three 6-inch headers. Two of the headers are dedicated to the native soil trenches and one of the headers is dedicated to the southern "landfilled" soils. Vapor flow rates and induced vacuum can be controlled at each of the 3-inch extraction lines through individual 3-inch ball valves. The SVE lines also include individual ½-inch ball valves for sampling the soil gas, monitoring induced vacuum levels and measuring airflow velocity.

The extraction header has been configured to allow isolation of each extraction line. Once individual trench pairs decline to an acceptable vapor level, the operator may begin an air injection program using the proposed AP-1 pump. After asymptotic extraction levels are reached, the use of injected air into various trench pairs will assist in remediating the site by varying "normal" airflow paths.

5.4 Condensate Knock-Out Tank K-1

After the extracted soil vapors are combined at the influent header, the influent vapors are routed through the K-1 condensate knockout tank. The K-1 tank is a 5 feet diameter low carbon steel tank. The VP-1 and VP-2 vacuum pumps create a vacuum atop the K-1 tank. All extracted soil vapors enter tangentially to the induced vacuum. After entering the tank, soil vapors travel vertically through a mist eliminator pad. The mist eliminator pad creates a high porosity environment for entrainment of liquids and soil moisture. As liquid droplets collect on the mist eliminator pad, the droplets fall to the bottom of the tank and collect as a reservoir.

Liquid level switches have been installed within the side of the K-1 tank and are interlocked with the PLC. At approximately 130 gallons of fluid the high level switch and the low-level switch will be activated. At this point the PLC will energize the air solenoid which controls the K-1 air operated drain valve. The K-1 drain valve opens and 30 seconds later the P-1 pump is energized. The P-1 pump transfers recovered condensate from the K-1 tank to the S-1 equalization tank.

Should a problem occur in the K-1 drain valve or the P-1 pump, an emergency high level switch is located at approximately 180 gallons of fluid. Once the K-1 emergency high level switch is activated, both vacuum pumps VP-1 and VP-2 are stopped until the system is manually reset.

5.5 K-1 Condensate Knock-out Pump (P-1)

Recovered liquid condensate and soil moisture is captured within the K-1 condensate tank. At a predetermined level, the K-1 high level switch will signal the PLC to energize the air solenoid for the K-1 drain valve. The air solenoid allows compressed air to open the K-1 drain valve. After a 30 second delay, the PLC then energizes the P-1 condensate pump. The P-1 pump transfers liquid condensate from the K-1 tank to the S-1 equalization tank.

The P-1 pump continues to operate until the liquid level within the K-1 tank drops to below the low-level switch at approximately 40 gallons of fluid remaining in the tank. At this point, all 3 level switches are down and the PLC energizes the second K-1 air solenoid and ceases the P-1 pump operation. The second air solenoid closes the K-1 drain valve completely isolating the K-1 tank.

The following are general specifications for the P-1 pump:

Model Number	CDU70 1 x 1-1/4 x 4-1/2
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	0.75 Hp, 460 volt, 3 Phase, 3450 RPM
Final Pump	
Motor Classification	X-P, NEMA 7
Normal Operating Conditions	4 gpm @ 20 ft TDH
Maximum NPSH	< 2.0 feet

Pump Manufacturer and Manufacturers' Representative

Ebara International	R&J Associates
1813-C Associates Lane	34 Terrace Avenue
Charlotte, North Carolina 28217	East Hartford, Connecticut 06108
(704) 357-1352	(860) 289-4441

END OF SECTION

SECTION 6

SVE Off-Gas Conditioning System

6.1 Description and Function of the System

The extracted soil gas is heated by compression within the vacuum pumps and continues to have a relatively high moisture content. Vapor phase carbon adsorption is a process that is most effective on a cool and dry air stream with a relatively stable volatile organic load. In order to pre-condition the SVE gas before treatment by the vapor GAC units, the treatment system includes an air-to-water heat exchanger and a secondary knockout pot.

6.2 SVE Off-gas Heat Exchanger

The post vacuum pump air stream is anticipated to have a normal temperature of 160 to 185 degrees F. Based on carbon adsorption isotherms, carbon capacity for most chlorinated compounds increases by a factor of 2 to as high as a factor of 8 when air temperature is lowered from 170°F to 100°F.

The heat exchanger uses system process water from T-2 at an anticipated influent temperature of 45 to 85°F to cool copper coils within the heat exchanger. SVE process air is passed across the coils, thus cooling the SVE air stream. The heat exchanger has the following general specifications:

Normal Air Flow	2,400 cfm
Normal Water Flow	0.75 to 7 gpm
Maximum Influent Air Temp	205°F
Normal Influent Water Temp	40 to 85°F
Design Effluent Air Temp	100°F
Design Effluent Water Temp	132°F
Air Pressure Loss	4" Water
Water Pressure Loss	8 psi @ 8 gpm
Manufacturers Model No.	C-200
Manufacturer Serial No.	0198-B5610
Manufacturer	Xchanger, Inc. 1401 South 7th Street Hopkins, Minnesota 55343
Manufacturer Phone	612.933.2559

6.3 Secondary Knock-out Tank (K-2)

After the soil vapors are cooled within the air-to-water heat exchanger, liquid condensate droplets will form both in the air stream and within the heat exchanger. The K-2 secondary knockout tank has been installed to capture and collect remaining liquid condensate within the air stream.

The K-2 tank is similar in design to the K-1 tank, but slightly smaller. The K-2 tank is a 3-feet diameter low carbon steel tank. The cooled soil vapor air stream enters tangentially to the air exit through the top of the tank. After entering the tank, soil vapors travel vertically through a mist eliminator pad. The mist eliminator pad creates a high porosity environment for entrainment of liquids and soil moisture. As liquid droplets collect on the mist eliminator pad, the droplets fall to the bottom of the tank and collect as a reservoir.

Liquid level switches have also been installed within the side of the K-2 tank and are interlocked with the PLC. At approximately 50 gallons of fluid the high level switch and the low-level switch will be activated. At this point the PLC will notify the operator an alarm condition is occurring and the K-2 tank must be manually drained. The operator is allowed sufficient time to manually drain the tank before the emergency high-high level switch is activated.

Should the operator fail to manually drain the K-2 tank, the emergency high level switch is located at approximately 75 gallons of fluid. Once the K-2 emergency high level switch is activated both vacuum pumps VP-1 and VP-2 are stopped until the system is manually reset.

END OF SECTION

SECTION 7

SVE TRENCH DEWATERING SYSTEM

7.1 Description and Function of the System

The project specifications require remediation of the native soils from original grade to a depth of 9 feet below grade. Although seasonal water elevation information is not readily available, distinct monitoring visits have identified shallow water as high as 6 feet below grade. A dewatering system was installed within each of the native SVE trenches to extend the seasonal effectiveness of the SVE system.

Each of the SVE trenches was excavated from existing grade to a minimum depth of 8 feet below grade. The trenches were installed in geometric pattern running east-west with each trench 40 feet in length. After excavating, the native soil was stockpiled for cover of the SVE trenches. Crushed and sorted gravel fragments from the concrete pad were placed within the backfill of each trench. A 1.5-inch dewatering point was installed within the bottom of each of the native trenches. The dewatering points were brought to grade with PVC pipe and interconnected to PVC suction lines. Every three dewatering points were connected to one common dewatering suction line.

A total of 21 vacuum dewatering lines run from the treatment building to the various SVE trenches. The dewatering lines are segregated into 6 groups of 3 and 4 well manifolds. The 6 common manifolds are connected to 6 double diaphragm pumps for dewatering the SVE trenches.

7.2 Double Diaphragm Dewatering Pumps

The six- (6) double diaphragm pumps (DDP) operate independently of each other. The DDP's are air operated with individual airlines and individual pneumatic controls including:

- ✓ air regulators to regulate the vacuum created by the pumps
- ✓ needle valves to control the speed of the pump cycle
- ✓ air solenoids controlled by the PLC to regulate the length of each pump cycle

The DDP's are positive displacement, suction lift pumps. As compressed air is injected to one side of a flexible diaphragm, fluids on the other side of the diaphragm are discharged. When the compressed air is released to the atmosphere, the diaphragm quickly returns to its original shape, creating a vacuum that draws fluid into the expanding chamber. With a diaphragm on each side of the pump, one diaphragm is always in compression (discharge) while the other side is in expansion (suction). In this way the pumps are self-priming and will remove air from the extraction lines until the water reaches the pumps.

The operator should be familiar with the general sound of the DDP pump operation. A characteristic "chugging" noise is the trademark of the DDP's. During periods when the pump is removing only air, the pump will cycle or chug very quickly with a sharp "snap" of the air relief valve. When removing water (which is much denser) the pump will slow down and form a rhythmic cycling period. If the pump is operated at high speeds without removing water, the flexible diaphragms will tear and the pumps will not operate.

The following are general specifications regarding the six DDP's:

Normal Suction Lift	12 feet vertical or 11-inches Hg Suction
Average Recovery Rate	3.5 gpm @ 11" Hg Suction
Maximum Recovery Rate	7 gpm @ 4" Hg Suction
Maximum Backpressure	< 5 psi
Normal Air Consumption	15 scfm per pump during priming at 11" Hg
Normal Air Pressure	45 to 60 psi
Maximum Air Pressure	100 psi
Inlet/ Outlet Pipe Size	1" NPT
Maximum Solids Size	¼" Diameter
Manufacturers Name	All-Flo
Manufacturers Model No.	NC-10 Polypropylene Body w/ Buna Diaphragms
Manufacturers Representative	R&J Associates 34 Terrace Avenue East Hartford, Connecticut 06108 (860) 289-4441

7.3 Dewatering Vacuum Switches

Water level measurements within each of the individual SVE trenches cannot be accurately determined. The DDP's are designed to be self priming and can operate "pumping" air for long periods of time, however periods when the system pumps air place an undue strain on the diaphragm materials. In order to allow the dewatering system to operate as independently as possible, vacuum switches have been installed within the suction lines for each of the DDP's.

The vacuum switches simply monitor the vacuum level created by the individual DDP's. During period of priming, the vacuum on each of the suction lines will continually increase until the line is fully primed. If the SVE trenches are dry and the DDP's are removing only air, a vacuum will not be created.

The vacuum switches are adjustable and operate at a normal range of 8 to 28-inches of mercury. As initially set, the vacuum switches are set at 8-inches of mercury. When the system is initially started, the PLC will energize the 6 air solenoids for the 6 dewatering pumps. Each system is allowed a period of 10 minutes to 30 minutes as determined by the operator to create a vacuum within the dewatering lines.

If there is water within the SVE trenches, a vacuum will be created and the vacuum switch will close. This signals the PLC to continue operating the DDP. If there is no water within the SVE trenches, no vacuum will be created and the vacuum switch will remain open. If the vacuum switch is open after the designated priming period, the PLC will close the air solenoid and the system will wait an operator-determined period of time for the pump to again restart.

If after pumping for a period of time and the SVE trench becomes dewatered the vacuum switch will open and the PLC will close the air solenoid for the DDP. Again the DDP will remain off-line for a period of time determined by the operator before attempting to reprime.

7.4 S-1 Equalization Tank

Recovered water from the 6 DDP's is pumped into a 550-gallon common equalization tank (S-1) which is located directly beneath the DDP table. The S-1 tank provides equalization for the recovered water, as well as the K-1 condensate water, the contained floor sump water, the manually drained K-2 condensate and water from the manual backwash pump.

The S-1 tank is fitted with a 3 station level switch. When water reaches the high switch level, the P-2 surface mounted transfer pump is energized and the recovered water is pumped directly to the T-2 influent tank. The P-2 pump continues to operate until the water in S-1 falls below the low-level switch.

The third level switch in S-1 is an emergency high switch. Should P-2 fail to remove the water in S-1 fast enough, the emergency high switch will signal the PLC to close the air solenoid valves for the DDP's until the water level in S-1 falls below the low level switch.

7.5 S-1 Transfer Pump (P-2)

A surface mounted transfer pump (P-2) transfers water from S-1 to T-2, the raw influent water tank. The operation of the P-2 pump is controlled through the PLC. P-2 is energized when the S-1 tank reaches the high water level switch. P-2 remains operating until the water level in S-1 falls below the low water level switch. The following are general specifications for the P-2 pump:

Model Number	CDU70/3 1 x 1-1/4 x 5-3-16
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	1.5 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	X-P, NEMA 7
Normal Operating Conditions	20 gpm @ 50 ft TDH
Maximum Pump Conditions	35 gpm @ 25 ft TDH

Pump Manufacturer and Manufacturers' Representative

Ebara International	R&J Associates
1813-C Associates Lane	34 Terrace Avenue
Charlotte, North Carolina 28217	East Hartford, Connecticut 06108
(704) 357-1352	(860) 289-4441

7.6 Air Compressor Unit

The double diaphragm pumps are powered by compressed air. The use of compressed air meets the requirements for the building interior to be explosion proof. Compressed air also allows additional flexibility in adjusting the operation of the DDP's. During periods of DDP priming, large volumes of air are consumed and the air compressor must be capable of meeting these periods of high demand.

The air compressor and air receiver are a self-contained unit. The compressor is capable of two-phase operation as determined by the operator. During periods of low air consumption, the compressor can run in ON-OFF mode, where pressure within the receiver is built up and the compressor shuts off.

During periods of full load, the compressor controls include an automatic unloader system. The compressor motor runs constantly with compressed air fed to the receiver until a pre-determined pressure is reached. At this point, the supply line to the receiver is closed and the unloader valve is opened. Although air is continually compressed within the compressor head, the air is immediately exhausted to the atmosphere allowing the compressor to run while expending minimal energy.

The following are specifications for the compressor system:

12 hour Constant air supply	60 scfm @ 100 psi
1 hour intermittent air supply	85 scfm @ 100 psi
1 hour intermittent air demand	80 scfm @ 60 psi
Normal Continual air demand	45 scfm @ 60 psi
Normal compressor operation	24 hours per day; 365 days per year
Compressor tank size	120 gallons
Electrical service	20 Hp, 460 volt, 3 Phase
Particle Filtration	< 5 microns
Coalescing Condensate Removal	< 50% relative humidity @ 80 Deg F
Manufacturers Model No.	CL20CUB
Compressor Type	Rotary Screw

Compressor Manufacturer and Manufacturers Representative

Compare LeRoi	Airmatic Compressor
PO Box 927	PO Box 4047
211 East Russell Road	275 Huyler Street
Sidney, Ohio 46365	South Hackensack, New Jersey 07606
937.498.2500	201.342.1300

Specific maintenance and replacement items:

Compressor Oil Type	SSL-50 Semi-synthetic lubricant
Compressor Oil Change Frequency	4,000 hours -or approximately every 6 months
Coalescing Filter Cartridge	ZEKS Model 140LTG – Direct indicating gauge

END OF SECTION

SECTION 8

T-2 and T-4 STORAGE TANKS

8.1 Description and Function of the System

The operation of the SVE recovery and treatment system has been designed for an automatic unmanned 24 hour per day operation. As per the project specifications, operation of the water treatment system must occur under the supervision of an Indiana licensed wastewater treatment operator. Because of the limitation in water treatment, two steel bolt-together 150,000-gallon tanks have been constructed at the site to store influent and effluent water.

The T-2 influent tank is distinguished from the T-4 effluent tank by a plastic cover. Under normal conditions, a clean air compressor provides air to diffusers within the bottom of T-2. The constant airflow to the inside of T-2 provides an air bubble that lifts the T-2 cover. Trapped air beneath the T-2 cover is routed through two (2) 180-pound vapor phase GAC units before discharge to the atmosphere.

T-2 provides accumulation of recovered water during periods when the operator is not onsite. Point level control floats have been installed within T-2. Specific attention is paid to the High #1 level control float, which will notify the operator when T-2 reached 65% of capacity. At this time the operator will respond to the site conditions and treat the influent water through the onsite treatment equipment.

The T-4 effluent tank is closer to the treatment building than the T-2 tank, and does not have a tank cover. Under normal conditions, the T-4 tank will remain nearly empty. All system effluent is normally routed from the treatment system to the T-4 tank for storage prior to discharge.

8.2 T-2 Influent Tank

The T-2 influent tank has a nominal tank capacity of 150,000 gallons of water. The tank was manufactured onsite by using steel exterior panels, which were bolted together for tank support. Each steel panel is 5 feet high and approximately 8 feet long with a slight dish to the steel. The T-2 and T-4 tanks include 3 tiers of these 5 feet high panels. The exterior tank dimensions for each tank are 15 feet tall and 43 feet in diameter.

Impermeable liners and poly fiber geotextile material are sandwiched on the inside of the tank system. Beginning with the material closest to the ground surface and the tank steel walls the following interior liners are installed within the tanks:

- ✓ 10 oz per square yard poly-fiber geotextile ground cover
- ✓ 30 mil XR-5 reinforced leak detection secondary impermeable liner
- ✓ 10 oz per square yard poly-fiber geotextile interspace liner (between the two impermeable liners)
- ✓ 30 mil XR-5 reinforced primary water containment liner.

The T-2 tank also includes an XR-5 tank cover. The cover allows capture and containment of the air and vapors from the aerators installed within the bottom of the T-2 tank.

8.3 BL-400 T-2 Aeration Blower and Aerators

The BL-400 blower is a clean air rotary vane compressor. Atmospheric air is drawn through a particulate filter, compressed to a maximum pressure of 15 psi and injected into the 5 tank aerators within the bottom of T-2. Within the aerators the compressed air is segmented into small bubbles and allowed to rise to the air water interface. As the air rises beneath the T-2 tank cover, the cover rises and creates an air bubble between the water level in T-2 and the cover. Additional compressed air beyond the volume of the T-2 cover is routed via two 3-inch airlines to two 180-pound vapor phase GAC canisters. The vapor GAC canisters remove any volatile organics that have been stripped from the influent water before discharge of the air to the atmosphere.

Aeration of T-2 has two distinct purposes. First, the minimal air movement provides sufficient circulation to provide mixing of the tank influent. By continually mixing the water, a consistent treatment system influent is maintained which assists in evaluating long term system performance.

Second, the addition of atmospheric air increases the dissolved oxygen within the water and encourages oxidation of any metals within the water, including iron. Most metallic compounds decrease in solubility at a higher valence state increasing the potential for metals removal within the TSS filters in the treatment system.

The following are general specifications for the BL-400 blower:

Minimum Air Flow	18 scfm
Maximum Required airflow	30 scfm
Maximum Allowable air flow	50 scfm
Min air pressure (T-2 near empty)	70 inches-of-water pressure
Max air pressure (T-2 full)	200 inches-of-water pressure
Motor Classification	TEFC

8.4 T-2 Off-gas GAC Units

The injection of air into the raw influent water in T-2 has the potential to strip volatile organics from the water. In order to minimize the release of contaminants to the atmosphere, two vapor phase granular activated carbon units (GAC's) have been installed beneath the walkway.

The two GAC's are installed in series. Captured air from beneath the T-2 cover is routed to a PVC vapor influent line to the primary GAC unit. After primary vapor treatment in the lead GAC unit, vapors are routed through the secondary GAC unit and then to the atmosphere.

The following are general specifications for the T-2 off-gas GAC units:

Maximum air flow rate	100 scfm
Normal influent air flow rate	30 scfm
Carbon capacity	180 pounds per unit
Maximum backpressure	10-inches of water per unit
Air Inlet and Outlet piping	1.5" Female NPT
Manufacturers Model No.	GPC-3
Manufacturers Name	Carbonair, Inc. 2731 Nevada Avenue North New Hope, Minnesota 55427
Manufacturers Phone	612.544.2154

8.5 T-4 Effluent Tank

After treatment the operator will normally route all system effluent to the T-4 effluent tank. The T-4 tank is constructed identical to the T-2 tank, except the T-4 tank is open to the atmosphere at the top.

The P-200 effluent pump and the P-300 recirculation pump are connected to a common T-4 drain line. The P-300 pump provides a means of returning some water from the T-4 tank to the T-2 influent tank to provide redundant treatment scenarios or to provide wash water within T-2. The P-300 pump operation is manually controlled through the Panel View MMI.

The P-200 pump is normally used for the discharge of treated T-4 water to the onsite drainage swale and the surface water of Indiana. The P-200 pump operation may be automatically controlled by the PLC or manually controlled through the Panel View MMI.

8.6 Leak Detection Liners and Leak Detection Sumps

The T-2 and T-4 tanks are constructed atop a compacted soil foundation, but the secondary tank liner is open direct percolation to the ground in the cases of a liner failure. The use of a dual liner system with a geotextile interstitial spacing provides a means of leak detection. Should the primary liner fail, the released fluid will be captured within the interstitial space between the primary and the secondary liners.

The secondary liner includes a bottom drain that is installed within the middle of the tank system. All fluid released through the primary liner gravity drains to this secondary liner drain. An elbow at approximately 3 feet below the tank bottom routes the liner drain to approximately 3 feet away from the edge of the tank. A 12-inch diameter PVC vertical sump pipe is connected to the 4-inch drain line from each secondary liner. The sealed leak detection sump allows the collection and storage of drained interstitial fluid.

Portable 120-volt sump pumps have been installed within each of the leak detection sumps. The sump pumps transfer recovered interstitial fluids from the leak detection sumps directly back to the individual tanks, T-2 or T-4. The sump pumps operate with an integral float system and maintain the water level below the bottom of the tank floor.

Leak detection level switches have also been installed within the two leak detection sumps. The leak detection switches are set at 2-inches above the floor of each tank. Normally the portable sump pumps will maintain minor seepage water below the level of the leak detection sump. Should a major breach in the primary liner occur, the water level within the leak detection sump would quickly equalize with the internal tank water level, thus tripping the leak detection sump switch. If the leak detection sump switches are activated, the PLC causes the system to go into an alarm condition and notify the system operator.

8.7 Tank Level Controls

Liquid level switches are suspended within each of the tanks, T-2 and T-4. The level switches include a bright yellow PVC jacket and are easily visible in T-4 from the operator platform. The following is a listing of the various tank levels and the condition each switch controls through the PLC.

T-2 Influent Tank Level Switches

Low Low Tank Level	38" Above Tank Floor	31,650 gal	Ceases Pump Operation	Normal Closed
Low Tank Level	54" Above Tank Floor	45,000 gal	Ceases Pump Operation	Normal Closed
High #1 Tank Level	124" Above Tank Floor	103,200 gal	Starts P-100 Pump	Normal Open
High #2 Tank Level	146" Above Tank Floor	121,500 gal	Starts P-100 Pump	Normal Open
Emergency High-High Tank Level	158" Above Tank Floor	131,500 gal	Ceases P-2 Pump Operation & Operator Alarm	Normal Open

T-4 Effluent Tank Level Switches

Low Low Tank Level	36" Above Tank Floor	30,000 gal	Ceases Pump Operation	Normal Closed
Low Tank Level	54" Above Tank Floor	45,000 gal	Ceases Pump Operation	Normal Closed
High Tank Level	132" Above Tank Floor	110,000 gal	Starts P-200 Pump	Normal Open
Emergency High-High Tank Level	156" Above Tank Floor	130,000 gal	Ceases P-1A/ P-1B Pump Operation & Operator Alarm	Normal Open

Using a ladder, the operator can change the location of the tank level switches. Because of the height of the tanks and the manual adjustment of each tank level switch, Handex does not recommend changing any of the designated tank levels. If tank levels are changed, this Operations and Maintenance manual as well as the operator's log must be noted.

END OF SECTION

SECTION 9

TRANSFER AND PROCESS PUMP SYSTEMS

9.1 Description and Function

The treatment system includes several integrated treatment units. The various surface mounted transfer pumps maintain the system operational. The PLC and the motor starter/overload protection units in the Motor Control Center (MCC) control all pumps. The motor starters include amperage overload protection and thermal overload protection for each of the motors. The following describes each of the process pumps including their specifications and details. Appendix H includes a generalized Operation and Maintenance manual for the surface mounted transfer pumps.

9.2 Air Stripper Influent Pumps (P100A & P100B)

Recovered wastewater is equalized and aerated within the T-2 tank. At the pre-set level switch locations (See section 8) the PLC and remote monitoring unit (RMU) will notify the operator when the liquid level within T-2 is at 65% of capacity.

An Indiana licensed wastewater treatment operator must be onsite whenever the treatment system is started. If the T-2 tank is above 65% capacity, the operator need only begin the P-100 pump operation and the air stripper to begin processing water. The P-100 pumps transfer water from the T-2 tank through the two initial suspended solids filters and into the air-stripping unit. Once the high level switch #1 is contacted, the P-100 pumps will continue to operate until the T-2 low level switch is deactivated or an alarm conditions occurs within the rest of the system.

The following are general specifications for both of the P-100 pumps:

Model Number	3U32-200 1-1/4 x 2 x 7-5/16
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	7.5 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	X-P NEMA 7
Normal Operating Conditions	35 gpm @ 185 ft TDH
Operational Limitations	15 gpm @ 212 ft TDH & 155 gpm @ 55 ft TDH

Pump Manufacturer and Manufacturers' Representative

Ebara International
1813-C Associates Lane
Charlotte, North Carolina 28217
(704) 357-1352

R&J Associates
34 Terrace Avenue
East Hartford, Connecticut 06108
(860) 289-4441

9.3 GAC Feed Pumps (P1A & P1B)

Air stripper effluent gravity drains into the integral equalization sump within the bottom of the air-stripping unit. At predetermined levels, the level switches within the air stripper sump interface with the PLC to energize the GAC feed pumps. The pumps transfer air stripper effluent through two suspended solids filters and then through the two granular activated carbon units in series. After solids and carbon filtration, the final system effluent is pumped directly to the T-4 effluent tank.

The following are general specifications for both of the P-1 pumps:

Model Number	3U32-200 1-1/4 x 2 x 7-5/16
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	7.5 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	X-P NEMA 7
Normal Operating Conditions	50 gpm @ 179 ft TDH
Operational Limitations	15 gpm @ 212 ft TDH & 155 gpm @ 55 ft TDH

Pump Manufacturer and Manufacturers' Representative

Ebara International	R&J Associates
1813-C Associates Lane	34 Terrace Avenue
Charlotte, North Carolina 28217	East Hartford, Connecticut 06108
(704) 357-1352	(860) 289-4441

9.4 K-1 Condensate Knock-out Pump (P-1)

Recovered liquid condensate and soil moisture is captured within the K-1 condensate tank. At a predetermined level the K-1 high level switch will signal the PLC to energize the air solenoid for the K-1 drain valve. The air solenoid allows compressed air to open the K-1 drain valve. After a 30 second delay, the PLC then energizes the P-1 condensate pump. The P-1 pump transfers liquid condensate from the K-1 tank to the S-1 equalization tank.

The P-1 pump continues to operate until the liquid level within the K-1 tank drops to below the low-level switch at approximately 40 gallons of fluid remaining in the tank. At this point, all 3 level switches are down and the PLC energizes the second K-1 air solenoid and ceases the P-1 pump operation. The second air solenoid closes the K-1 drain valve completely isolating the K-1 tank.

The following are general specifications for the P-1 pump:

Model Number	CDU70 1 x 1-1/4 x 4-1/2
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	0.75 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	X-P, NEMA 7
Normal Operating Conditions	4 gpm @ 20 ft TDH
Maximum NPSH	< 2.0 feet

Pump Manufacturer and Manufacturers' Representative

Ebara International	R&J Associates
1813-C Associates Lane	34 Terrace Avenue
Charlotte, North Carolina 28217	East Hartford, Connecticut 06108
(704) 357-1352	(860) 289-4441

9.5 S-1 Equalization Tank (P-2)

A surface mounted transfer pump (P-2) transfers water from S-1 to T-2, the raw influent water tank. The operation of the P-2 pump is controlled through the PLC. P-2 is energized when the S-1 tank reaches the high water level switch. P-2 remains operating until the water level in S-1 falls below the low water level switch. The following are general specifications for the P-2 pump:

Model Number	CDU70/3 1 x 1-1/4 x 5-3-16
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	1.5 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	X-P, NEMA 7
Normal Operating Conditions	20 gpm @ 50 ft TDH
Maximum Pump Conditions	35 gpm @ 25 ft TDH

Pump Manufacturer and Manufacturers' Representative

Ebara International	R&J Associates
1813-C Associates Lane	34 Terrace Avenue
Charlotte, North Carolina 28217	East Hartford, Connecticut 06108
(704) 357-1352	(860) 289-4441

9.6 Heat Exchanger Feed Pump (P-7)

The air-to-water heat exchanger that cools the vacuum pump effluent air is fed water from the T-2 tank. The heat exchanger pump (P-7) draws water from the bottom of the T-2 tank, pumps the water through a primary screen and through the heat exchanger. The flow rate of the heat exchanger cooling fluid is important to the cooling of the SVE air. Under normal conditions the P-7 pump runs constantly unless water levels within T-2 fall to the low-low tank level or the S-1 tank has an emergency high level.

The following are general specifications for the P-7 pump:

Model Number	CDU70 1 x 1-1/4 x 4-1/2
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	0.75 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	X-P, NEMA 7
Normal Operating Conditions	1 to 7 gpm @ 73 to 65 ft TDH

Pump Manufacturer and Manufacturers' Representative

Ebara International	R&J Associates
1813-C Associates Lane	34 Terrace Avenue
Charlotte, North Carolina 28217	East Hartford, Connecticut 06108
(704) 357-1352	(860) 289-4441

9.7 Treated Water Effluent Pump (P-200)

Treated water in T-4 can normally gravity drain to the discharge pipe in the drainage swale near the system. The operator must manually start the T-4 pump P-200 and then allow the PLC to control the pump operation.

The following are general specifications for the P-200 effluent pump:

Model Number	CDU200/3 1 x 1-1/2 x 5-3/16
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	3.0 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	X-P, NEMA 7
Normal Operating Conditions	70 gpm @ 35 ft TDH
Operational Limitations	15 gpm @ 128 ft TDH & 80 gpm @ 85 ft TDH

Pump Manufacturer and Manufacturers' Representative

Ebara International	R&J Associates
1813-C Associates Lane	34 Terrace Avenue
Charlotte, North Carolina 28217	East Hartford, Connecticut 06108
(704) 357-1352	(860) 289-4441

9.8 Recirculation Pump (P-300)

The treatment system includes a recirculation pump P-300. The recirculation pump allows the operator to return water from the T-4 effluent tank to the T-2 influent tank. The P-300 will not normally be operated because the system design should provide 99% treatment with one pass through the system. Because of the suction header design for the P-200/P-300 pumps, the P-300 pump can only pump T-4 down to a level of 4 feet. Further drainage of T-4 must be completed by a piping modification or manual drainage.

The following are general specifications for the P-300 recirculation pump:

Model Number	CDU200/3 1 x 1-1/2 x 5-3/16
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	3.0 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	X-P, NEMA 7
Normal Operating Conditions	80 gpm @ 45 ft TDH
Operational Limitations	15 gpm @ 128 ft TDH & 80 gpm @ 85 ft TDH

Pump Manufacturer and Manufacturers' Representative

Ebara International 1813-C Associates Lane Charlotte, North Carolina 28217 (704) 357-1352	R&J Associates 34 Terrace Avenue East Hartford, Connecticut 06108 (860) 289-4441

9.9 Backwash Pump

Although bag filtration units are included before and after the air stripper, accumulation of some suspended solids within the liquid phase GAC units may be expected. In order to remove the solids from the top of the GAC beds and to provide resorting of the carbon particles within the bed, a clean water recirculation pump has been included with the system. The recirculation pump draws water from the T-4 effluent tank and would pump water up through the normally "down-flow" GAC units. Water and solids from the GAC units will be pumped to T-2 for equalization and return treatment.

The operator must be especially cautious with the manual operation of the backwash pump. The pump is relatively powerful, and the connection to the GAC units through high-pressure hoses may be difficult for some operators. The backwash pump will not operate for a period greater than 15 minutes, and will not operate unless sufficient water exists within the T-4 tank AND sufficient freeboard exists within the T-2 tank.

The following are general specifications for the manual backwash pump:

Model Number	A3U-40-200A (150T3C) 1-1/2 x 2-1/2 x 7-3/16
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	15.0 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	TEFC
Normal Operating Conditions	65 gpm @ 230 ft TDH
Operational Limitations	20 gpm @ 240 ft TDH & 250 gpm @ 160 ft TDH

Pump Manufacturer and Manufacturers' Representative

Ebara International 1813-C Associates Lane Charlotte, North Carolina 28217 (704) 357-1352	R&J Associates 34 Terrace Avenue East Hartford, Connecticut 06108 (860) 289-4441

END OF SECTION

SECTION 10

SUSPENDED SOLIDS FILTERS

10.1 Description and Function of the System

Suspended solids and small particulate matter are always present in some quantity and some form in all water remediation systems. Although no suspended solids limit has been established by IDEM, the TSS filters have been installed as maintenance control items. Removal of suspended solids before the flow instrumentation, the air stripping system and the GAC units prolongs the life of each unit and maximizes system operational time.

The treatment system utilizes four identical bag filter units (BF-1 through BF-4). The bag filters are paired (BF-1/ BF-2 and BF-3/ BF-4) for treatment before the air stripping unit and before the GAC units respectively. The system piping includes a valve arrangement allowing the filters to be bypassed, any one of the filters to operate, or the two filters to operate in series. The OPERATOR must be fully aware of the piping system before altering any valves. The original system configuration will be lead-lag for both filter sets.

The following is a general specification for the four bag filter units:

Model Number	88-30-2-N-A-C-15
Housing Material	Low Carbon Steel
Basket Size	8-inch diameter x 30-inch length
Normal Operating Conditions	35 gpm @ <10 psi pressure drop
Operational limitations	120 gpm @ 10 psi pressure drop
Maximum Vessel Pressure	150 psi

Solids filter manufacturer and Manufacturer's representative:

Krystil Klean Filtration	Filtration/ Flow Inc.
Route 2, Box 300	13 Princeton Drive
Winamac, Indiana 46996	Jackson, New Jersey 08527
800.869.0325	732.901.0280

10.2 Replacement Filters, Sizes and Options

The choice of optimum filter sock sizes is the responsibility of the operator and must continually be re-evaluated as the system operates. The following is a listing of the textile filter micron sizes as specified by the original system design. The operator may choose to maintain these filter sizes or to vary filter sizes to optimize system performance.

BF-1 Primary filter before air stripper	50 microns
BF-2 Secondary filter before air stripper	25 microns
BF-3 Primary filter before GAC units	5 microns
BF-4 Secondary filter before GAC units	5 microns

The following is a listing of "standard" textile filter socks that may be obtained with minimal delivery time. When the operator orders new filter socks, simply specify an 8-inch x 30-inch textile sock and the micron sizes desired.

200 microns	150 microns	125 microns	100 microns
75 microns	60 microns	50 microns	40 microns
30 microns	25 microns	20 microns	10 microns
5 microns	2 microns		

The following are potential filter sock vendors:

Filtration/Flow Inc. 13 Princeton Drive Jackson, New Jersey 08527 (732) 901-0280	WACO, Inc. 7 Industrial Road Wood-Ridge, New Jersey 07075 (201) 935-5400

10.3 Pressure Drop and Cleaning

All influent and effluent piping to each of the bag filters includes visual indicator pressure gauges. The OPERATOR must use both visual indications (sample clarity) and back pressure indications to identify when to replace the filter bags. Handex normal operating procedures defines a backpressure across the filter housing greater than 20 psi indicates a "plugged" bag unit. Most filter manufacturers, however, specify pressure drops as high as 60 psi across the bags is acceptable before change-out.

The OPERATOR must be cautious both when opening and closing the filter housing. If opened while still under pressure, personal injury may result. ALWAYS CONFIRM THERE IS NO PRESSURE ON A FILTER BEFORE ATTEMPTING MAINTENANCE.

Likewise when closing the filter, the OPERATOR must be sure the top of the filter housing is clean and the 0-ring is properly seated. If the 0-ring is not seated, the filter unit may leak or "blow-out" at the 0-ring spraying the area with impacted water.

END OF SECTION

SECTION 11

CARBONAIR LOW PROFILE AIR STRIPPER SYSTEM

11.1 Description and Function of the System

The primary contaminants within the soil and, therefore, surface runoff water across the site are volatile organic compounds (VOC's). Air stripping has proven to be a cost effective and mechanically viable alternative for the treatment of VOC's as documented by the EPA, the API and other agencies.

The Carbonair low profile air stripper is designed to provide 99.5% removal of all volatile organic compounds which are anticipated within the influent stream. The GAC system will act as a secondary polishing system to confirm compliance with the IDEM discharge approval.

Raw influent is pumped from the T-2 influent tank, through the primary TSS filters and directly into the low profile air stripper. The air stripper is designed for removal of dissolved volatile contaminants at a maximum flow rate of 35 gallons per minute, however the stripper can treat a hydraulic load exceeding 60 gpm without flooding. The operator must be fully aware of all influent and treatment criteria to assure proper system performance.

The process uses forced draft, counter-current air stripping across baffled aeration trays to remove dissolved VOC's from the water. Impacted groundwater is pumped into the air stripper and atomized by a spray nozzle above the top treatment tray. The atomized water collects within the tray and runs across each baffle to a downspout on the opposite corner of the tray. Clean air is blown up through the 3/16" diameter holes in each of the aeration trays to form a froth of bubbles. The froth creates a large surface area for mass transfer of contaminants from the dissolved phase to the air phase.

Air stripper off-gas including VOC contaminants are routed out of the top of the stripper and combine with the SVE air stream. The combined air stream mixes before entering the vapor phase GAC vessels.

The manufacturer Operation and Maintenance manual for the air stripper is provided in Appendix J.

11.2 System Construction

The air stripper trays and integral settling sump are constructed of 304 stainless steel sheeting. The 4 air stripping trays are stacked atop each other and interlock by stainless steel snap connectors. The packaged unit is warranted for mechanical performance as well as treatment performance for a period of one year.

The following is a general specification for the air stripping system:

Manufacturers Model number	STAT-180
Number of treatment trays	4
Dimensions of Skid	88" wide x 86" deep x 94" tall
Stripper Construction Material	304 Stainless Steel
Maximum Influent Flow Rate	60 gpm (manufacturers literature)
Design Influent Flow Rate	35 gpm continual
Number of Air Blowers	One
Air Stripper Manufacturer	Carbonair, Inc. 8640 Monticello Lane Maple Grove, Minnesota 55369-4547
Manufacturers Phone	612.425.2992

11.3 Air Stripper Blower Operation

The air stripper blower provides the counter current air stream for the stripping action within the unit. The blower draws fresh air from within the treatment building and forces the air into the sump/base of the air stripper body. The air rises across the stripper trays and exits the stripper through a mist eliminator pad. Effluent air ducting routes the stripper off-gas to merge with the SVE off-gas stream and then through the vapor phase GAC units before discharge to the atmosphere.

A New York Blower Operation and Maintenance manual is included within the air stripper O&M manual in Appendix J. The following are general specifications for the air stripper blower:

Model Number	2306A
Blower Speed	3500 RPM Direct Drive
Motor Rating	10 Hp, 3 Phase, 460 volt
Electrical Classification	X-P, NEMA 7
Normal Operating Conditions	900 cfm @ 44" Water Column
Other	Blower Inlet Silencer Automatic Air Flow Damper on blower inlet Air Flow pitot tube and direct read gauge
Blower Manufacturer	New York Blower Company 7660 Quincy Street Willowbrook, Illinois 60521

11.4 System Controls and Instruments

Air stripping is a relatively simple technology. As long as airflow into the unit, the influent water temperature, the influent air temperature and the differential system pressure remain consistent, the system will work as designed. Treatment system 'upsets' occur under two generalized scenarios:

a) A major change in airflow occurs and a relatively large system upsets with decreased system efficiency.

Possible cause: Blockage of the influent air duct; blower motor failure; closing of the influent air damper; closure of the effluent air damper, sudden blockage of the air stripper trays.

b) A very slow and minor decline in airflow occurs and a minor decline in system performance occurs.

Possible cause: The air stripper trays are becoming fouled by inorganics, the vapor phase GAC units are becoming plugged.

In order to avoid either upset condition from occurring, the system includes air-monitoring instrumentation for the air stripper. The air-monitoring instruments include:

1) An influent air flow differential pressure monitor. This provides the operator with a direct read of the airflow into the system.
2) An air pressure gauge on the base of the stripper. By measuring increases in backpressure, the operator can judge the cleanliness of the stripper trays.
3) A low air pressure switch interlocked with the PLC. If the air stripper blower does not blow a minimal amount of air into the stripper, the low air pressure switch will contact and alarm the PLC of a problem condition.

Level control switches have also been installed within the sump of the air stripper. The 5 level switch interlock with the PLC to control the operation of the P-1, GAC feed pumps. Should a problem occur causing the water level in the stripper sump to rise, the PLC will cease the operation of the P-100 air stripper feed pumps before the stripper floods. If the stripper should flood, water can enter the blower that could ruin the bearings in the blower or the blower motor or cause electrical harm to site personnel.

END OF SECTION

SECTION 12

GRANULAR ACTIVATED CARBON UNITS

12.1 Description and Function

The US EPA and IDEM have approved the discharge of treated water. Because of the potential for influent water quality variations and the high level of operator responsibility, the system design includes treatment redundancies.

The air stripping system has been designed to provide greater than 99.5% per Section 11, removal of volatile organics, however, the granular activated carbon units provide a treatment redundancy. The two GAC units are installed in series with sampling points and pressure gauges before and after each unit. The primary GAC unit has been sized to provide 100% compliance with the volatile organic limitations for a period greater than 21 days. The secondary GAC units provide back-up assurances while adsorption occurs within the primary unit.

12.2 System Construction

The GAC units are ASME rated, reinforced fiberglass pressure vessels rated to 150 psi. The 36-inch diameter vessels include top and bottom entry/exit ports. Each port is a 3-inch male NPT opening. The only internal piping is a bottom "spider-web" collection laterals. The units may be piped in either up flow or down flow operation. As originally installed the GAC units have been piped in down flow operation, with influent water entering the top and effluent water exiting at the bottom.

Appendix K includes specification sheets for the GAC units. The following are general specifications for the GAC units:

Flow Capacity	50 gpm maximum
Vessel Size	36" diameter x 72" tall
Vessel Construction	Reinforced fiberglass
Vessel Liner	Vinylester
ASME pressure Rating	150 psig
Carbon Capacity	900 lbs dry weight
Wet Vessel Weight	2,200 lbs
Recommended Carbon Type	8 x 30 mesh
Normal Operating Conditions	40 to 45 gpm @ < 9 psi pressure drop
Normal Pressure Conditions	40 psi @ 40 gpm as set by effluent ball valves
Manufacturer Model No.	PC 7F
Manufacturer	Carbonair, Inc. 8640 Monticello Lane Maple Grove, Minnesota 55369-4547
Manufacturers Phone	612.425.2992

12.3 GAC Operation and Controls

The rate of carbon consumption is based upon several conditions. The operator must monitor the entire system operation when inspecting the system. During the first months of operation the operator must monitor the combined system influent, the air stripper effluent quality, TSS filter pressures and removal efficiencies, the GAC influent pressure and the GAC effluent quality. As defined in Section 10.0 the TSS solids removal systems should capture suspended solids before the GAC units. If a solids removal upset occurs, oxidized metals and solids may blanket the top of the GAC units and cause a pressure increase in the GAC's.

Additional components are included within the mechanical piping of the system and integral to the GAC operation. Adsorption by activated carbon is a physical process. Maintaining the GAC bed fully flooded without the presence of any air is critical. To maintain a fully "wet bed" the bottom outlet piping exits the vessel and rises above the height of the vessel effluent. A "pressure set" vacuum break is installed. The vacuum break allows a small quantity of air to enter the pipeline and allow the effluent water downstream of the vacuum break to siphon drain, while maintaining the GAC vessels fully wet.

The influent piping to each vessel includes a spring-loaded brass relief valve. Although the maximum head pressure of the largest pump (the backwash pump) is 135 psi, and the pressure rating of the vessels are 150 psi the GAC's should not experience a pressure over 75 psi. Maintaining a less than 75-psi, operating pressure lowers the potential for crushing the carbon structure.

The pressure relief valves drain relief water to the building floor sump. As defined in Section 2.0, Emergency Shut Down Procedures; the operator must assess the building conditions prior to entering. If the building floor is wet or includes standing water the system may be shut down using the electrical disconnects in the MCC on the outside of the building before entering the building.

12.4 Manual Backwash Pump

Although bag filtration units are included before and after the air stripper, accumulation of some suspended solids within the liquid phase GAC units may be expected. In order to remove the solids from the top of the GAC beds and to provide resorting of the carbon particles within the bed, a clean water recirculation pump has been included with the system. The recirculation pump draws water from the T-4 effluent tank and would pump water up through the normally "down-flow" GAC units. Water and solids from the GAC units will be pumped to T-2 for equalization and return treatment.

The operator must be especially cautious with the manual operation of the backwash pump. The pump is relatively powerful, and the connection to the GAC units through high-pressure hoses may be difficult for some operators. The backwash pump will not operate for a period greater than 15 minutes, and will not operate unless sufficient water exists within the T-4 tank AND sufficient freeboard exists within the T-2 tank.

The following are general specifications for the backwash pump:

Model Number	3U 40-200A 1-1/2 x 2-1/2 x 7-3/16
Pump Material	304 Stainless Steel with Viton Mechanical Seal
Motor Horsepower	15.0 Hp, 460 volt, 3 Phase, 3450 RPM
Motor Classification	TEFC
Normal Operating Conditions	65 gpm @ 140 ft TDH
Operational Limitations	20 gpm @ 240 ft TDH & 250 gpm @ 160 ft TDH

Pump Manufacturer and Manufacturers' Representative

Ebara International
1813-C Associates Lane
Charlotte, North Carolina 28217
(704) 357-1352

R&J Associates
34 Terrace Avenue
East Hartford, Connecticut 06108
(860) 289-4441

END OF SECTION

SECTION 13

VAPOR OFF-GAS TREATMENT SYSTEM

13.1 Description and Function

The discharge of treated soil vapors and air stripper off-gas has been approved by the US EPA and IDEM. Because of the potential for influent air quality variations, the system design includes a 100% redundant GAC system. The vapor phase GAC units are two parallel rows of two units piped in series, with automatic vapor sampling points and temperature monitors after each unit. The secondary GAC units provide back-up assurances while adsorption occurs within the primary unit.

13.2 Carbon Vessel Construction

The vapor phase GAC units are welded steel vessels. The 16.5 feet long vessels include dual bottom inlets and dual top outlets. The units are piped in series with effluent from the primary unit entering the influent side of the secondary unit.

Appendix L includes specification sheets for the vapor phase GAC units. The following are general specifications for the GAC units:

Flow Capacity	900 to 33,000 scfm continual
Vessel Size	(4) 24" dia. x 60" long
Vessel Construction	Welded Low Carbon Steel
Vessel Pressure Rating	100-inches of water
Carbon Capacity	3,000 lbs
Manufacturer Model No.	VF-3000
Manufacturer	TetraSolv Filtration 1200 E. 26th Street Anderson, IN 46016
Manufacturers Phone	765-643-3941

13.3 Normal Operational Conditions

Adsorption by activated carbon is a physical process. The rate of carbon consumption is based upon several conditions. The operator must monitor the entire system operation when inspecting the system. During the first months of operation the operator must monitor the combined system influent, the air stripper effluent quality, the SVE extraction rate and removal efficiencies through both GAC units to determine system performance.

Additional components are included within the process piping of the system and integral to the GAC operation. The instrumentation components are included within Section 14.0, Instrumentation and Controls. The following points describe the interaction of the instrumentation and the affect each component monitors.

- Temperature monitors are included on the raw influent to the GAC's, the effluent of the primary GAC and the effluent from the secondary GAC. Because adsorption is an exothermic process, the higher the contaminant load to the system, the higher the temperature rises through the system.

- The operator must be aware of the system temperatures at all times. The carbon bed temperature should never rise above 190 degrees F.

- The vapor analyzer monitors the total hydrocarbons that are processed by the system. The flame ionization detector (FID) unit automatically cycles between monitoring the system influent, the mid-point between the GAC units and the final system effluent quality.

- A relative humidity sensor is included on the raw influent system piping immediately before the primary GAC unit. Humidity control is a crucial variable for the long-term operation of the system. If the influent vapors have a high relative humidity value, the potential for condensation and carbon blocking by water droplets increase. The raw influent to the system should have a relative humidity value less than 50%.

END OF SECTION

SECTION 14

INSTRUMENTATION AND CONTROLS

14.1 Description and Function

The field instrumentation mounted throughout the system is critical to the system operation. The instruments include digital (On or Off) switches and analog transmitters which send scaleable signals. The analog instruments utilized for this project include 4 basic types; pressure sensing/ pressure transmitters, humidity sensing transmitter, Resistance Temperature Detectors (RTD) and volatile organic Flame Ionization Detector (FID) transmitter.

The PLC panel includes intrinsic barriers and terminal strips for connection of all field wiring. All field connections for the digital instruments and for the power outputs to the MCC are along the terminal bar at the bottom of the panel. All field connections for the analog instruments are isolated on the intrinsic barriers on the vertical left-hand side of the panel. From the PLC to the various instruments, all instrumentation wiring is enclosed within isolated instrumentation conduits. At no time does instrumentation wiring encroach upon power supply wiring by less than 3-inches of separation.

Each field instrument has been factory tested prior to shipment. Upon receipt and installation of the instruments, each unit was checked for "relative accuracy". Extreme care should be taken whenever working with the instrumentation. All units include some type of printed circuitry and close tolerance contacts. Inadvertent electrical surges or mechanical shocks (e.g. dropping a unit) will quickly disable the units and may cause personal injury.

14.2 Tank and Sump Level Switches

Several types of digital level switches are used throughout the system. In general, the level switches within the various tanks control the system operation, while the level switches within the leak detection sumps and treatment building floor sump serve as a system control function. Each level switch is integrated with the PLC and powered by an Allen-Bradley intrinsic barrier. The intrinsic barrier controls the electrical current to the switches and maintains all electrical power at a level below any potential for a spark. The following is a general list of level switches and a description of the units and their location:

Switch Identification	Switch Location and Function
T2LOLO	T-2 Emergency Low Level Float
T2LO	T-2 Low Level Float
T2HI1	T-2 Primary High Level Float @ 65% Tank Capacity
T2HI2	T-2 Secondary High Level Float
T2HIHI	T-2 Emergency High Level Float
T4LOLO	T-4 Emergency Low Level Float
T4LO	T-4 Low Level Float
T4HI	T-4 High Level Float
T4HIHI	T-4 Emergency High Level Float
T2LDS	T-2 Leak Detection Sump Level Switch

T4LDS	T-4 Leak Detection Sump Level Switch
ASLOLO	Air Stripper Emergency Low Level Switch
ASLO	Air Stripper Low Level Switch
ASHI1	Air Stripper High Level Switch – Primary Pump
ASHI2	Air Stripper High Level Switch #2
ASHIHI	Air Stripper Emergency High Level Switch
S1LO	S-1 Low Level Switch
S1HI	S-1 High Level Switch
S1HIHIH	S-1 Emergency High Level Switch
K1LO	K-1 Condensate Knock-out Low Level Switch
K1HI	K-1 Condensate Knock-out High Level Switch
K1HIHI	K-1 Condensate Knock-out Emergency High Level Switch
K2LO	K-2 Condensate Knock-out Low Level Switch
K2HI	K-2 Condensate Knock-out High Level Switch
K2HIHI	K-2 Condensate Knock-out Emergency High Level Switch
FLSLO	Floor Sump Low Level Switch
FLSHI	Floor Sump High Level Switch
FLHIHI	Floor Sump Emergency High Level Switch

T-2 and T-4 Tank Level Switches

Model Number	LV612-P
Type	Rectangular SPDT Non-Mercury Suspended Float
Manufacturer	OMEGA Engineering, Inc. PO Box 2669 Stamford, Connecticut 06906-0669
Manufacturer Phone	1-800-826-6342

T-2 Influent Tank Level Switches

T2LOLO	38" Above Tank Floor	31,650 gal	Ceases Pump Operation	Normal Closed
T2LOW	54" Above Tank Floor	45,000 gal	Ceases Pump Operation	Normal Closed
T2HI1	124" Above Tank Floor	103,200 gal	Starts P-100 Pump	Normal Open
T2HI2	146" Above Tank Floor	121,500 gal	Starts P-100 Pump	Normal Open
T2HIHI	158" Above Tank Floor	131,500 gal	Ceases P-2 Pump Operation & Operator Alarm	Normal Open

T-4 Effluent Tank Level Switches

T4LOLO	36" Above Tank Floor	30,000 gal	Ceases Pump Operation	Normal Closed
T4LO	54" Above Tank Floor	45,000 gal	Ceases Pump Operation	Normal Closed
T4HI	132" Above Tank Floor	110,000 gal	Starts P-200 Pump	Normal Open
T4HIHI	156" Above Tank Floor	130,000 gal	Ceases P-1A/ P-1B Pump Operation & Operator Alarm	Normal Open

T-2 and T-4 Leak Detection Sump Level Switches

Model Number	LS-750 (stock number 149390)
Type	Suspended, Factory Sealed PVC Float within outer brass and clear protective casing
Supplier	TrueTech Controls. 356 Skillmand Road Skillman, New Jersey 08552
Suppliers Phone	609.466.3200

T-2 and T-4 Leak Detection Sump Level Switches

T2LDS	2" Above Tank Floor	1.25 gal	Operator Alarm Condition	Normal Open
T4LDS	2" Above Tank Floor	1.25 gal	Operator Alarm Condition	Normal Open

Air Stripper Integral Sump Level Switches

Model Number	Level Control Switch
Type	Factory Sealed 5 point SS Floats on SS Shaft
Supplier	Carbonair, Inc. 8640 Monticello Lane Maple Grove, Minnesota 55369-4547
Suppliers Phone	612.425.2992

Air Stripper Level Switches

ASLOLO	9" Above Tank Floor	118 gals	Emergency Low P-1A & P-1B Pumps Off	Normal Closed
ASLO	11.5" Above Tank Floor	150 gals	Low P-1A & P-1B Pumps Off	Normal Closed
ASHI1	19" Above Tank Floor	250 gals	Primary P-1A or P-1B Pump On	Normal Open
ASHI2	22" Above Tank Floor	285 gals	Secondary P-1A or P-1B Pump On	Normal Open
ASHIHI	23.5" Above Tank Floor	310 gals	P-100 A/B Feed Pumps OFF and Operator Alarm Condition	Normal Open

S-1 Equalization Tank Level Switches

Model Number	4000- 3 Point
Type	Factory Sealed 3 point PVC Floats on PVC Shaft
Supplier	Thomas Products, LTD. 987 West Street Southington, Connecticut 06489
Suppliers Phone	800.666.9101

S-1 Equalization Tank Level Switches

S1LO	19" Above Tank Floor	260 gals	Low Level P-2 Pump Off	Normal Closed
S1HIGH	36" Above Tank Floor	410 gals	High Level P-2 Pump On	Normal Open
S1HIHI	40" Above Tank Floor	490 gals	Emergency High DDP Pumps OFF	Normal Open

K-1 Knock-out Tank Level Switches

Model Number	LS-4100-SS
Type	Stainless Steel Side Mount Sealed Switches
Supplier	Flow Plus Inc. 1690 Lake Drive West Chanhassen, Minnesota 55317
Suppliers Phone	612.361.6452

K-1 Knock-out Tank Level Switches

K1LO	12" Above Tank Bottom	40 gals	Low Level P-1 Pump Off & K-1 Valve Close	Normal Open
K1HIGH	36" Above Tank Bottom	320 gals	High Level P-1 Pump On & K-1 Valve Open	Normal Open
K1HIHI	42" Above Tank Bottom	380 gals	Emergency High Vacuum Pumps OFF	Normal Open

K-2 Knock-out Tank Level Switches

Model Number	LS-4100-SS
Type	Stainless Steel Side Mount Sealed Switches
Supplier	Flow Plus Inc. 1690 Lake Drive West Chanhassen, Minnesota 55317
Suppliers Phone	612.361.6452

K-2 Knock-out Tank Level Switches

K2LO	12" Above Tank Bottom	20 gals	Low Level Panel View Screen Only	Normal Open
K2HIGH	27" Above Tank Bottom	65 gals	High Level Panel View Screen Only	Normal Open
K2HIHI	31" Above Tank Bottom	77 gals	Emergency High Vacuum Pumps OFF	Normal Open

Building Floor Sump Level Switches

Model Number	43765
Type	Factory Sealed PVC Float with splashguard
Supplier	TrueTech Controls. 356 Skillmand Road Skillman, New Jersey 08552
Suppliers Phone	609.466.3200

Building Floor Sump Level Switches

FLSLO	18" Below Building Floor	~10 gal	P-7 DDP Air Solenoid Off- Pump Off	Normal Open
FLSHI	8" Below Building Floor	~25 gal	P-7 DDP Air Solenoid On – Pump On	Normal Open
FLHIHI	4" Below Building Floor	~30 gal	Emergency High ALARM Condition – All Systems OFF	Normal Open

14.3 Dewatering Pump Vacuum Switches

Depth to water level measurements within each of the individual SVE trenches cannot be accurately determined. The DDP's are designed to be self priming and can operate "pumping" air for long periods of time, however, periods when the system pumps air place an undue strain on the diaphragm materials. In order to allow the dewatering system to operate as independently as possible, vacuum switches have been installed within the suction lines for each of the DDP's.

The vacuum switches simply monitor the vacuum level created by the individual DDP's. During period of priming, the vacuum on each of the suction lines will continually increase until the line is fully primed. If the SVE trenches are dry and the DDP's are removing only air, a vacuum will not be created.

The vacuum switches are adjustable and operate at a normal range of 8 to 28-inches of mercury. As initially set, the vacuum switches are set at 8-inches of mercury. When the system is initially started, the PLC will energize the 6 air solenoids for the 6 dewatering pumps. Each system is allowed a period of 10 minutes to 30 minutes as determined by the operator to create a vacuum within the dewatering lines.

If there is water within the SVE trenches, a vacuum will be created and the vacuum switch will close. This signals the PLC to continue operating the DDP. If there is no water within the SVE trenches, no vacuum will be created and the vacuum switch will remain open. If the vacuum switch is open after the designated priming period, the PLC will close the air solenoid and the system will wait an operator-determined period of time for the pump to again restart.

If after pumping for a period of time and the SVE trench becomes dewatered the vacuum switch will open and the PLC will close the air solenoid for the DDP. Again the DDP will remain off-line for a period of time determined by the operator before attempting to reprime.

The following are general specifications regarding the vacuum switches:

Model Number	DA-7031-153-2
Vacuum Range	8 to 28-inches of Hg
Contact	Dual Contact- Normal Open/ Normal Closed
Manufacturer	Dwyer Instruments PO Box 373 Michigan City, Indiana 46360
Manufacturer Phone	219.879.8000

14.4 Flow Meter Systems

Flow rate and total flow monitoring is critical to the monitoring of the system performance. Instantaneous flow rate and total flow meter readings should be recorded at every visit. The flow meter systems through the process are all identical and supplied by one manufacturer.

The process flow meters are positive displacement meters with analog direct indicating flow totalizers. The following are flow meter locations and general specifications for the flow meter systems:

Flow Meter Type & Locations	M70	P-100 Air Stripper Influent
	M70	P-1A/ P-1B GAC Effluent
	M70	P-1 K-1 Knock-out Pump
	M70	P-2 S-1 Equalization Pump
	M70	P-7 Heat Exchanger Pump
	M70	DDP-1 and DDP-2 Combined Flow
	M70	DDP-3 and DDP-4 Combined Flow
	M70	DDP-5 and DDP-6 Combined Flow
	M120	P-200 Final Effluent Pump

Model Numbers	RCDL M70 – 1" Flow Meter RCDL M120 – 1 ½" Flow Meter
Body Material	Bronze Body
Flow Rating	M70 = 1 to 70 gpm M120 = 2 to 120 gpm
Pressure Rating	150 psi
Accuracy	1.5% Over full flow range
Supplier	WR Frew Co. Inc. 2144 East 52nd Street Indianapolis, Indiana 46205
Supplier Phone	317.253.3271

14.5 Air Velocity Probes

Monitoring the gas flow rate through the system is critical to long term monitoring of the process. The project site includes two identical flow velocity sensors for monitoring gas flow in two distinct locations:

a. Total SVE air flow after the heat exchanger and K-2
b. Total airflow to the vapor phase GAC systems including the SVE and air stripper off-gas air streams.

The flow sensors themselves are very simplistic and should require little attention. The sensors are solid pieces of ¼-inch diameter brass with machined air pressure ports on two sides of the sensor. The air pressure ports are then interconnected to isolate high and low pressure valves. Air pressure lines from each of these valves are then connected to differential pressure sensors to measure the pressure differential across the upstream and downstream flow ports.

The following is a general specification for the two flow sensors:

Model Number	DS-400-12
Pipe Size	12-inch Pipe Diameter
Insertion Length	Complete Insertion – 1/16-inch air gap
Estimated Accuracy	+- 2% at any flow rate
Manufacturer	Dwyer Instruments PO Box 373 Michigan City, Indiana 46360
Manufacturer Phone	219.879.8000

14.6 Differential Pressure Transmitters

The air flow sensors measure upstream and downstream differential pressure across a pitot tube. The differential pressure across the pitot tube is in direct proportion to the airflow through the pipe. Two differential pressure transmitters have been installed to interface with the two airflow sensors. The 4 to 20 ma signal from the each of the differential pressure transmitters is integrated with the PLC. Through a mathematical calculation the Panel View MMI will use the differential pressure information and the temperature information to calculate, the mass airflow through the system. The following is the "standard" airflow equation based on the pitot tube manufacturer.

Q (scfm) = 128.8 x K x D^2 x Square Root [(P x Delta P / (T +460) x Ss)]

Q = Air Flow in scfm
C = 128.8 is a conversion constant
K = Flow Coefficient Constant for the Pitot Tube
= 0.683 based on manufacturer testing
D = Inside Diameter of the Pipe (inches)
= 12-inches for the existing system piping
P = Static Line Pressure (psia)
= (GAC Backpressure (IWC) / 27.96) + 14.7
Delta P = Differential Pressure Indicator Reading (inches of water column)
= DP transmitter Reading
T = Air Temperature in the flow line (Degrees F)
Ss = Specific gravity of gas – assumed to be 1.0 for air at STP
= 1.0 (but may vary based on humidity readings)

Sample Calculation from an actual site reading:
Pitot Tube Differential Pressure = 1.1 – IWC
Air Temperature of the Flow Line = 98 Degrees F
Vapor GAC Backpressure = 25 – IWC

1. Air Flow Rate = 128.8 x 0.683 x 12^2 x [SQRT $\frac{((14.7+25/27.96) \times 1.1)}{[(460+98) \times 1]}$]

2. Vapor Air Flow Rate = 12,667.77 x SQRT $\frac{(17.1535)}{558}$

3. Vapor Air Flow Rate = 12,667.77 x SQRT 0.03074 = 12,667.77 x 0.17533

4. Vapor Air Flow Rate = 2221 scfm

The following are general specifications for the two different differential pressure transmitters:

a. <u>SVE Air Flow Differential Pressure Transmitter</u> – Inside Treatment Building

Model No.	EJA110A-DMS4B-1 92NA/FF1/D1 D/P
Differential Pressure Range	0 to 6 inches of Water Column
Direct Reading Dial	No Direct Reading Output
Electrical Classification	X-P, NEMA 7
Electrical Output	4 to 20 ma Linear scaling
Accuracy	+/- 0.50% of Full Scale
Manufacturer	Yokogowa Instruments, Inc.
Supplier	True Tech Controls, Inc. 356 Skillman Road Skillman, New Jersey 08558
Supplier Phone	609.466.3200

b. <u>TOTAL GAC Air Flow Differential Pressure Transmitter</u> – Outside Treatment Building

Model No.	DP 505-6
Differential Pressure Range	0 to 6 inches of Water Column
Direct Reading Dial	Front Mounted Direct Reading Scale
Electrical Classification	Rainproof NEMA 4
Electrical Classification	Explosionproof with UL Intrinsic Barrier
Electrical Output	4 to 20 ma Linear scaling
Accuracy	+ - 5% of Full Scale
Manufacturer	Dwyer Instruments PO Box 373 Michigan City, Indiana 46360
Manufacturer Phone	219.879.8000

14.7 Resistance Temperature Devices

The following are general specifications for the four resistance temperature devices:

Model No.	PR-12-2-100-1/4-6-E
Normal Temperature Range	-20 to 250 Degrees F
Wiring Configuration	3 Wire RTD
Direct Reading Dial	No Direct Reading Output
Electrical Classification	NEMA 4, Water Tight Cover
Secondary Electrical Classification	Intrinsically Safe with UL Intrinsic Barrier
Electrical Output	Direct Read Scaleable Resistance
Accuracy	+/- 1% of Full Scale
Manufacturer	OMEGA Engineering, Inc. PO Box 2669 Stamford, Connecticut 06906-0669
Manufacturer Phone	1-800-826-6342

14.8 Relative Humidity Detector

The following are general specifications for relative humidity transmitter:

Model No.	HDM 60UO
Humidity Range	0 to 98% RH Across Temp Range
Temperature Range	-40 to 200 Degrees F
Direct Reading Dial	No Direct Reading Output
Electrical Classification	NEMA 4
Secondary Electrical Classification	Intrinsically Safe with UL Intrinsic Barrier
Electrical Output	4 to 20 ma Linear scaling
Accuracy	+/- 2% of Full Scale
Manufacturer	Vaisala, Inc. 100 Commerce Way Woburn, Massachusetts 01801
Manufacturer Phone	781.933.4500

14.9 Flame Ionization Detector (Continuous Total Hydrocarbon Analyzer)

The following are general specifications for the flame ionization detector

Model No.	Series 8800
Fuel Gas	Instrument Grade Hydrogen
Fuel Consumption	40 cc/min
Zero Air Gas	Hydrocarbon Free Air (post air compressor)
Zero Air Gas Consumption	25 cc/min
Calibration Standard	Propane

Compound	Anticipated Maximum Air Concentration ppm-v
Methane	200
Benzene	250
Chloroform	150
1,1 Dichloroethane	100
1,1 Dichloroethylene	100
Ethylbenzene	150
1,1,2,2-Tetrachloroethane	150
Vinyl Chloride	150

Electrical Classification	NEMA 4 Enclosure
Analog Output	4 to 20ma Linear scaling
Accuracy	+/- 0.50% of Full Scale

Manufacturer	MSA- Baseline Industries, Inc. PO Box 649 Lyons, Colorado 80540 800.321.4665
Supplier	Vanguard Controls Inc. 101 Landing Road Landing, New Jersey 07850
Supplier Phone	973.398-0702
Supplier Fax	973.398.6608

END OF SECTION

SECTION 15

PROGRAMMABLE LOGIC CONTROLLER

15.1 Description and Function

The Programmable Logic Control (PLC) panel controls the operations of the recovery and treatment systems. The PLC panel is a 5 feet wide by 6 feet tall, steel electrical panel located immediately outside of the treatment building beneath the building overhang. The panel includes a 24 volt DC power supply for the various field instruments, 120 volt circuit breakers for the smaller loads, the Allen Bradley PLC components and racks, a front mounted Man Machine Interface (MMI) plus barrier strips for all field connections.

The PLC is pre-programmed to monitor the condition of all instruments and control the operation of all motors. The PLC itself is divided into two different types of units: input monitoring and output control. A PLC provides greater flexibility in the system control and operation over a "hard-wired" relay based control system. By monitoring individual instrument points (e.g., Tank 2 Level) the PLC can be programmed to provide control for multiple motors (e.g. Tank 2 Level controls the operation of P-100A/ P-100B, P-2, P-300 and backwash pumps). The system complexity is only limited by the programmer's abilities and the number of I/O points: therefore, the operator must be familiar with the entire system operation and interaction of the components.

The PLC panel is Underwriters Certified to meet industry quality and safety features for a NEMA 4 environment. The PLC panel and programming was provided by the following:

Kirby Risk Electrical Supply
1440 West 16th Street
Indianapolis, Indiana 46202-2002
(317) 687-0015

15.2 PLC Programming Logic

The following is a verbal outline describing the operation of the system on a motor-by-motor basis. Appendix O includes electrical drawings detailing the design and construction of the PLC panel, Appendix P includes a complete description of the PLC program and Appendix Q includes a PLC operation and oversight manual prepared by Allen Bradley for the various PLC components.

MOTOR PROGRAMMING OPERATION

PLC Slot #3 Output Card No.1 – Output 1
SVE Vacuum Pump VP-1

- ON WHEN

	A)	Operator H-O-A Switch is Auto
	B)	Remains ON

- OFF WHEN

	A)	VP-1 Temperature Switch is HIGH
OR	B)	K-1 High-High Level Switch is HIGH
OR	C)	K-2 High-High Level Switch is HIGH
OR	D)	GAC #1 Bed temperature is HIGH
OR	E)	Vapor Analyzer point #2 (GAC #1 Effluent) is HIGH
OR	F)	RMU Digital output #1 is OPEN (or CLOSED) dependent on RMU chosen
OR	G)	Operator H-O-A Switch is OFF
AND	H)	3 Minute delay to RESTART

PLC Slot #3 Output Card No.1 – Output 2
SVE Vacuum Pump VP-2

- ON WHEN

	A)	Operator H-O-A switch is AUTO
	B)	Remains always ON

- OFF WHEN

	A)	VP-2 Temperature Switch is HIGH
OR	B)	K-1 High-High Level Switch is HIGH
OR	C)	K-2 High-High Level Switch is HIGH
OR	D)	GAC #1 Bed temperature is HIGH
OR	E)	Vapor Analyzer Point #2 is HIGH
OR	F)	RMU Output #2 is alarmed
OR	G)	Operator H-O-A switch is OFF
AND	H)	3 Minute Delay to RESTART

PLC Slot #3 Output Card No.1 – Output 3
Air Injection Pump AP-1

- *ON WHEN*

	A)	Operator H-O-A Switch is AUTO
AND	B)	When VP-1 or VP-2 is running

- OFF WHEN

	A)	Both VP-1 and VP-2 are OFF
OR	B)	H-O-A Switch is OFF
OR	C)	Vapor Analyzer Point #1 is HIGH
AND	D)	Remains OFF for 5 minutes before restarting

PLC Slot #3 Output Card No.1 – Output 4
K-1 Knockout Pump P-1

➤ ON WHEN (After a 10 second delay for any of these conditions)

	A)	H-O-A Switch is ON and B OR C occur
	B)	When K-1 High Level Switch is HIGH
	C)	When K-1 High-High Level Switch is HIGH

➤ OFF WHEN

	A)	K-1 Low Level Switch is LOW
OR	B)	S-1 High-High Level Switch is HIGH
OR	C)	T-2 High-High Level Switch is HIGH
AND	D)	Remains OFF 1 minute before RESTARTING
OR	E)	H-O-A Switch is OFF

PLC Slot #3 Output Card No.1 – Output 5
S-1 Equalization Tank Pump P-2

➤ ON WHEN

	A)	H-O-A Switch is AUTO and B OR C occur
	B)	S-1 High Level Switch is HIGH
	C)	S-1 High-High Level Switch is HIGH

➤ OFF WHEN

	A)	S-1 Low Level Switch is LOW
OR	B)	T-2 High-High Level Switch is HIGH
AND	C)	Remains OFF 1 minute before RESTARTING
OR	D)	H-O-A Switch is OFF

PLC Slot #3 Output Card No.1 – Output 6
Spare

PLC Slot #3 Output Card No.1 – Output 7
Spare

PLC Slot #3 Output Card No.1 – Output 8
Spare

PLC Slot #3 Output Card No.1 – Output 9
T-2 Aeration Blower Control (Spare)

PLC Slot #3 Output Card No.1 – Output 10
P-100 A Air Stripper Influent Pump

- ON WHEN

	A)	When H-O-A Switch is Auto
AND	B)	If P-100 A is primary by operator switch-ON when T-High 1 Level Switch is HIGH. If not IGNORE High 1.
OR	C)	When T-2 High 2 Level Switch is HIGH
OR	D)	When T-2 High-High Level Switch is HIGH
AND	E)	Delay of 30 seconds to start after BL-100 starts

- OFF WHEN

	A)	T-2 Low Level Switch is LOW
OR	B)	T-2 Low Low Level Switch is LOW
OR	C)	Treatment Building floor sump is HIGH
OR	D)	Air stripper BL-100 is NOT running
OR	E)	Air stripper BL-100 High Pressure Switch is HIGH
OR	F)	Air stripper BL-100 High Low Pressure Switch is LOW
OR	G)	T-4 High-High Level Switch is HIGH
OR	H)	Air stripper High-High Level Switch is HIGH
OR	I)	RMU Output Number 3 is ALARM
OR	J)	H-O-A Switch is OFF

PLC Slot #3 Output Card No.1 – Output 11
P-100B Air Stripper Influent Pump

- ON WHEN

	A)	When H-O-A Switch is Auto
AND	B)	If P-100 B is primary by Operator Switch – ON when T-2 High 1 Level Switch is HIGH. If not IGNORE High 1.
OR	C)	When T-2 High 2 Level Switch is HIGH
OR	D)	When T-2 High-High Level Switch is HIGH
AND	E)	Delay of 30 seconds to start after BL-100 starts

- OFF WHEN

	A)	T-2 Low Level Switch is LOW
OR	B)	T-2 Low Low Level Switch is LOW
OR	C)	Treatment Building floor sump is HIGH
OR	D)	Air stripper BL-100 is NOT running
OR	E)	Air stripper BL-100 High Pressure Switch is HIGH
OR	F)	Air stripper BL-100 High Low Pressure Switch is LOW
OR	G)	T-3 High-High Level Switch is HIGH
OR	H)	T-4 High-High Level Switch is HIGH
OR	I)	Air stripper High-High Level Switch is HIGH
OR	J)	RMU Output Number 3 is ALARM
OR	K)	H-O-A Switch is OFF

PLC Slot #3 Output Card No.1 – Output 12
P-200 Final Effluent Pump

- ON WHEN

	A)	T-4 High Level Switch is HIGH
OR	B)	T-4 High-High Level Switch is HIGH
AND	C)	H-O-A Switch is Auto

- OFF WHEN

	A)	T-4 Low Level Switch is LOW
OR	B)	T-4 Low Low Level Switch is LOW
OR	C)	H-O-A Switch is OFF
OR	D)	RMU Output #5 is alarmed

PLC Slot #3 Output Card No.1 – Output 13
P-300 Recirculation Pump

- ON WHEN

	A)	T-4 High Level Switch is HIGH
OR	B)	T-4 High-High Level Switch is HIGH
AND	C)	H-O-A Switch is Auto

- OFF WHEN

	A)	T-4 Low Level Switch is LOW
OR	B)	T-4 Low Low Level Switch is LOW
OR	C)	H-O-A Switch is OFF
OR	D)	T-1 High-High Level Switch is HIGH
OR	E)	T-2 High-High Level Switch is HIGH

PLC Slot #3 Output Card No.1 – Output 14
Air Stripper Blower

- ON WHEN

	A)	Immediately upon start of either P-100 A or P-100 B
AND	B)	H-O-A Switch is auto

- OFF WHEN

OR	A)	Air stripper Low Pressure Switch is LOW for 30 seconds
OR	B)	4 Minute shut down after both P-100 A and P-100 B are OFF
OR	C)	H-O-A Switch is OFF

PLC Slot #3 Output Card No.1 – Output 15
GAC Influent (Air Stripper Effluent) P-1A Pump

➢ ON WHEN

	A)	If P-1A is Primary; air stripper High Level #1 Switch is HIGH
OR	B)	When air stripper High Level #2 Switch is High
OR	C)	When air stripper High-High Switch is HIGH
AND	D)	H-O-A Switch is AUTO

➢ OFF WHEN

	A)	Air stripper Low Level Switch is LOW
OR	B)	Air stripper Low Low Level Switch is LOW
OR	C)	T-4 High-High Level Switch is HIGH
OR	D)	H-O-A Switch is OFF

PLC Slot #3 Output Card No.1 – Output 16
GAC Influent (Air Stripper Effluent) P-1B Pump

➢ ON WHEN

	A)	If P-1B is Primary; air stripper High Level #1 Switch is HIGH
OR	B)	When air stripper High Level #2 Switch is High
OR	C)	When air stripper High-High Switch is HIGH
AND	D)	H-O-A Switch is AUTO

➢ OFF WHEN

	A)	Air stripper Low Level Switch is LOW
OR	B)	Air stripper Low Low Level Switch is LOW
OR	C)	T-4 High-High Level Switch is HIGH
OR	D)	H-O-A Switch is OFF

PLC Slot #4 Output Card No.2 – Output 1
Dewatering DDP-1 Air Solenoid

- ***ON WHEN***
  - A. Panel Mate Screen is Set to AUTO by Operator
  - B. Remains ON for a minimum of 10 minutes

- **OPERATED DESIGNATED OFF TIME WHEN** (Operator will input minutes, between 3 and 15 for an off time delay for each pump based on trench recharge rates.)
  - A) Vacuum Switch #1 is less than the designated set point
    NOTE: Must field determine if vacuum switch OPENS or closes at High Vacuum
  - OR B) S-1 High Level Switch is HIGH
  - THEN C) Solenoid Returns to Open and operates for a minimum of 10 minutes

- **PERMANENT OFF** POSITION AT THE PANEL MATE IF
  - A) S-1 High-High Level Switch is HIGH
  - OR B) Floor Sump High-High Level Switch is HIGH
  - AND C) Will not restart UNTIL Panel mate is reset to AUTO

PLC Slot #4 Output Card No.2 – Output 2
Dewatering DDP-2 Air Solenoid

- ***ON WHEN***
  - A) Panel Mate Screen is Set to AUTO by Operator
  - B) Remains ON for a minimum of 10 minutes

- **OPERATED DESIGNATED OFF TIME WHEN** (Operator will input minutes, between 3 and 15 for an off time delay for each pump based on trench recharge rates.)
  - A) Vacuum Switch #2 is less than the designated set point
  - B) NOTE: Must field determine if vacuum switch OPENS or closes at High Vacuum
  - OR B) S-1 High Level Switch is HIGH
  - THEN C) Solenoid Returns to Open and operates for a minimum of 10 minutes

- **PERMANENT OFF** POSITION AT THE PANEL MATE IF
  - A) S-1 High-High Level Switch is HIGH
  - OR B) Floor Sump High-High Level Switch is HIGH
  - AND C) Will not restart UNTIL Panel mate is reset to AUTO

PLC Slot #4 Output Card No. 2 – Output 3
Dewatering DDP-3 Air Solenoid

- *ON WHEN*

  A) Panel Mate Screen is Set to AUTO by Operator
  B) Remains ON for a minimum of 10 minutes

- **OPERATORDESIGNATED OFF TIME WHEN** (Operator will input minutes, between 3 and 15 for an off time delay for each pump based on trench recharge rates.)

  A. Vacuum Switch #3 is less than the designated set point
  NOTE: Must field determine if vacuum switch OPENS or closes at High Vacuum
  OR B) S-1 High Level Switch is HIGH

  THEN C) Solenoid Returns to Open and operates for a minimum of 10 minutes

- **PERMANENT OFF** POSITION AT THE PANEL MATE IF

  A) S-1 High-High Level Switch is HIGH
  OR B) Floor Sump High-High Level Switch is HIGH
  AND C) Will not restart UNTIL Panel mate is reset to AUTO

PLC Slot #4 Output Card No. 2 – Output 4
Dewatering DDP-4 Air Solenoid

- *ON WHEN*

  A) Panel Mate Screen is Set to AUTO by Operator
  B) Remains ON for a minimum of 10 minutes

- **OPERATOR DESIGNATED OFF TIME WHEN** (Operator will input minutes, between 3 and 15 for an off time delay for each pump based on trench recharge rates.)

  A) Vacuum Switch #4 is less than the designated set point
  NOTE: Must field determine if vacuum switch OPENS or closes at High Vacuum
  OR B) S-1 High Level Switch is HIGH

  THEN C) Solenoid Returns to Open and operates for a minimum of 10 minutes

- **PERMANENT OFF** POSITION AT THE PANEL MATE IF

  A) S-1 High-High Level Switch is HIGH
  OR B) Floor Sump High-High Level Switch is HIGH
  AND C) Will not restart UNTIL Panel mate is reset to AUTO

PLC Slot #4 Output Card No. 2 – Output 5
Dewatering DDP-5 Air Solenoid

- *ON WHEN*
  - A) Panel Mate Screen is Set to AUTO by Operator
  - B) Remains ON for a minimum of 10 minutes

- **OPERATED DESIGNATED OFF TIME WHEN** (Operator will input minutes, between 3 and 15 for an off time delay for each pump based on trench recharge rates.)

B) Vacuum Switch #5 is less than the designated set point
NOTE: Must field determine if vacuum switch OPENS or closes at High Vacuum
OR A) S-1 High Level Switch is HIGH

THEN B) Solenoid Returns to Open and operates for a minimum of 10 minutes

- **PERMANENT OFF** POSITION AT THE PANEL MATE IF
  - A) S-1 High-High Level Switch is HIGH
  - OR B) Floor Sump High-High Level Switch is HIGH
  - AND C) Will not restart UNTIL Panel mate is reset to AUTO

PLC Slot #4 Output Card No. 2 – Output 6
Dewatering DDP-6 Air Solenoid

- *ON WHEN*
  - A) Panel Mate Screen is Set to AUTO by Operator
  - B) Remains ON for a minimum of 10 minutes

- **OPERATED DESIGNATED OFF TIME WHEN** (Operator will input minutes, between 3 and 15 for an off time delay for each pump based on trench recharge rates.)

C) Vacuum Switch #6 is less than the designated set point
NOTE: Must field determine if vacuum switch OPENS or closes at High Vacuum
OR A) S-1 High Level Switch is HIGH

THEN B) Solenoid Returns to Open and operates for a minimum of 10 minutes

- **PERMANENT OFF** POSITION AT THE PANEL MATE IF
  - A) S-1 High-High Level Switch is HIGH
  - OR B) Floor Sump High-High Level Switch is HIGH
  - AND C) Will not restart UNTIL Panel mate is reset to AUTO

PLC Slot #4 Output Card No. 2 – Output 7 to Output #16
ALL Spare Outputs

PLC Slot #5 Output Card No.3 – Output 1 to Output # 8
ALL Spare Outputs

PLC Slot #5 Output Card No.3 – Output 9
Building Floor Sump DDP Air Solenoid

- **ON WHEN**

	A)	Floor Sump High Level is High
OR	B)	Floor Sump High High Level is High

- **OFF WHEN**

	A)	S-1 High-High Level Switch is HIGH
OR	B)	T-2 High-High Level Switch is High
OR	C)	Floor sump low level switch is below low

PLC Slot #5 Output Card No.3 – Output 10 & Output # 11
Spare Outputs

PLC Slot #5 Output Card No.3 – Output 12
RMU Alarm Channel #1

PLC Slot #5 Output Card No.3 – Output 13
RMU Alarm Channel #2

PLC Slot #5 Output Card No.3 – Output 14
RMU Alarm Channel #3

PLC Slot #5 Output Card No.3 – Output 15
RMU Alarm Channel #4

PLC Slot #5 Output Card No.3 – Output 16
RMU Alarm Channel #5

15.3 PLC Panel Mate Man Machine Interface

As defined above, the programming of the PLC uses various indicator levels for control of the system. An example is the T-2 tank level is monitored by five individual level switches. The PLC observes the T-2 tank level as monitored by the level switches and compares these levels to the critical level settings as defined by the programming.

An Allen-Bradley man machine interface (MMI) has been installed within the door of the PLC to allow the operator a graphical monitoring of the site features. The MMI provides a direct interface between the operator and the PLC operation. The MMI has a numerical and graphical keypad with a CRT screen that displays PLC and site information. The PLC non-volatile memory stores the written PLC program, however, the PLC data is monitored based on data input through the MMI screens. The operator is allowed to vary the critical values using the MMI at any time, however, once a value is manually changed, the PLC will continue to function using the new critical values.

Section 18 of this manual gives a complete listing of the initial and alarm site conditions as recommended by Handex. As the system is operated and refined, these set points may vary, however, if no other information is available, these values should provide a new starting point after a system failure or shut-down. Appendix R includes an Operation and Programming manual prepared by Allen Bradley for the Panel View system.

PRIOR TO ADJUSTING ANY OPERATIONAL SETPOINT, THE OPERATOR MUST BE FULLY AWARE OF THE VARIOUS INTERCONNECTIONS WITHIN THE PLC PROGRAM AND THE OPERATING UNITS. A TREATMENT SYSTEM UPSET OR OPERATIONAL FAILURE MAY OCCUR IF ANY OF THE SYSTEM SETPOINTS ARE INCORRECTLY CONFIGURED.

15.4 ISAAC Remote Monitoring Unit

The PLC panel has been equipped with an ISAAC FGD5000 remote monitoring unit (RMU) which is integrally mounted with the PLC. The RMU system is interwired with the PLC panel to provide operational data and control access from a remote location. The system includes an internal data-logger to document previous operational history and to help troubleshoot "stray" alarm conditions. The following is a list of RMU specifications:

Site Telephone Number	(317) 769-5984
Model:	ISACC FGD5000
Inputs:	16 Inputs, Either Digital or Scaleable Analog
Outputs:	12 Digital Outputs with an internal 5 V DC power supply 4 Analog Scaleable Outputs 1 High Voltage, 120 volt, 5 amp output
Manufacturer:	Phonetics, Inc. 901 Tryens Road Aston, PA 19014 (610) 562-2700

The following table is a list of pre-defined inputs and outputs for the system:

Input No.	Description	Normal Operation
1	VP-1 Pump Running	OK
2	VP-2 Pump Running	OK
3	K-1 Hi-Hi **OR** K-2 High **OR** S-1 Hi-Hi	OK
4	T-2 Hi #1 @ 65% Tank Capacity	OK
5	Floor Sump **OR** T-2 LDS **OR** T-4 LDS	OK
6	Vapor Anal Total Influent	0 to 100 ppm
7	Vapor Anal GAC #1 Eff	0 to 100 ppm
8	Vapor Anal Final Eff	0 to 100 ppm
9	SVE Air Flow	0 to 4000 scfm
10	GAC #1 Bed Temperature	- 40 to 300 F
11	Relative Humidity to GAC	0 to 100%
12	Spare	OK
13	Spare	OK
14	Spare	OK
15	Spare	OK

Output No.	Description	Normal Operation
1	VP-1 Emergency OFF	Normal Open
2	VP-2 Emergency OFF	Normal Open
3	P-100A and P-100B Emergency OFF	Normal Open
4	P-1A and P-1B Emergency OFF	Normal Open
5	P-200 Emergency OFF	Normal Open
6 to 12	SPARE OUTPUTS FOR FUTURE	Future

The system will automatically dial out to up to eight user defined telephone or beeper numbers to alert the user of alarm conditions. The numbers will be called in order until someone has been reached and the alarm acknowledged. The following phone numbers have been programmed into the system currently:

Notification Priority	Person	Telephone/Beeper No.
1	Dave Puchalski –Handex New Jersey	1.800.989.8511 e 241
2	Dave Puchalski Pager	1800.946.4646 610.8950
3	Handex of Indiana	(317) 228-6240
4	Handex of Indiana #2	(317) 228-6240
5	Spare	
6	Spare	
7	Spare	
8	Spare	

Appendix S includes a complete copy of an Operations and Instructions Manual for the RMU and the system software.

END OF SECTION

SECTION 16

TREATMENT EQUIPMENT ENCLOSURES

16.1 Description and Function

The treatment system and the air compressor utility buildings have been constructed as independent facilities on the Envirochem site. The system includes the two unique structures separated by approximately 2 linear feet. The two structures have been designed and constructed for their individual purposes. The following sections describe the various buildings, the appurtenant building features, specific safety guidelines to be followed for each structure and the building environments.

Air Compressor Utility Building

The air compressor utility building is a pre-made wooden structure that utilizes 2 x 4 lumber and a cast-in-place concrete floor for a foundation. The structure itself is wooden framed 2 x 4 construction with exterior building sheeting with a vapor barrier between the sheeting and the building interior. The inner walls of the building have not been insulated to allow an easier heat dissipation from the air compressor. The building includes a double access door and an air introduction roof ventilator.

Also housed within the air compressor building is the off-gas vapor analyzer. The vapor analyzer has been constructed within a NEMA 4 weatherproof enclosure that is fully sealed when operating. The placement of the vapor analyzer unit within the air compressor building provides added security to the analyzer.

Treatment Building

The treatment building is a pre-engineered steel structure with a cast-in-place concrete foundation. The interior environment of the treatment building does not exhibit the same noise and heat potential as the air compressor building; therefore, a "maintenance-free" steel building has been determined to be the most cost-effective structure.

ALTHOUGH THE TWO BUILDINGS ARE DESIGNED FOR A SAFE WORK ENVIRONMENT, THE BUILDINGS HOUSE VARIOUS CHEMICAL AND MECHANICAL PROCESSES. ONLY TRAINED AND AUTHORIZED PERSONNEL SHOULD ENTER EITHER BUILDING FOR ANY REASON.

16.2 Building Manufacturers

The wooden framed building was constructed onsite by a local building contractor. The AC building is 12 feet wide by 16 feet long and 9.5 feet at the building eaves. The air compressor is housed within the middle portion of the building with a minimum air clearance of 24-inches around the compressor. The northern portion of the building includes the air supply header to the various dewatering pumps, building sump pump and convenience air supply within the treatment building.

The treatment building is a pre-engineered metal structure manufactured by:

Parkline Northeast, Inc.
P.O. Box 65
Winfield, West Virginia 25213
(304) 586-2113

The treatment building is constructed on an integral metal panel and frame construction. The building is 32 feet wide by 46 feet long and 12 feet tall at the building eaves. The building also includes an eight feet wide roof overhang on the western portion of the building for protection of the electrical systems. The building includes three 36-inch entrance doors on the southern, western and northern building walls and a 10 feet wide overhead maintenance door on the western building wall.

The metal building is pre-primed and pre-painted. The building paint and wall liner paint includes a 10 year manufacturer warranty against defects. The interior of the building includes the steel "wall-rib" panels and a fire resistant white finish on the wall insulation.

16.3 Electrical Service and Electrical Disconnects

The electrical service to the recovery and treatment systems is property specific, dedicated electrical service to the treatment system. The service is run from a utility pole located along the Bankert property and out to Route 421. A 460-volt, 3 phase Current Transformer Cabinet is mounted between two utility poles near the southwestern property (main) entrance. Electrical service from the C-T cabinet then runs via onsite overhead poles near the storage tanks to the treatment building.

The following is a list of possible electrical disconnects the OPERATOR may use:

Electrical service to the *entire system including the treatment system and the air compressor building* may be shut off at two different locations:

1. The 600 amp, 480- volt knife-switch mounted near the entrance to the property, adjacent the electrical meter beneath the onsite utility poles.
2. Also at the PB-100 main 480-volt electrical control panel, by closing the 600 amp main breaker.

Electrical service to the *air compressor* may be shut off at two locations:

1. The PB-100 electrical control panel, by closing the 40-amp 460 volt 3 phase breaker at position 1A.
2. The knife-switch disconnect mounted on the air compressor adjacent to the air compressor integral control panel.

Electrical service to the *PLC system and associated instrumentation* may be shut off at the LP-100 circuit breaker #14, #16, #18 and #20. These 4 breakers all feed the PLC system and associated instrumentation.

Electrical service to the *PLC system alone* is shut off at the LP-100 circuit breaker #9 which feeds the 120-volt transformer.

Electrical service to the *treatment system HVAC and lighting features* may be shut off at the individual circuit breakers #1, #3, #5 and #7 within PB-100.

The various disconnects are listed for the operator to be aware of the system isolation features. The operator must be aware of the affects of ceasing power or restoring power to any motor or control system.

BEFORE ATTEMPTING TO PERFORM ANY ELECTRICAL WORK OR WORK OF ANY KIND WHICH MAY CREATE A SPARK, THE OPERATOR MUST EVALUATE HIS/HER OWN KNOWLEGE AND TRAINING. THIS WORK INCLUDES THE INSTALLATION OF TEMPORARY EXTENSION CORDS WITHIN THE BUILDING, TEMPORARY TELEPHONE SERVICES AND SMOKING.

16.4 Heating and Ventilation

Both of the system buildings include heating, lighting and ventilation. Both buildings include wall and ceiling insulation, however, due to different processes and environments, the various buildings utilize different HVAC components. The following is a listing of the heating and ventilation components used at the site:

Air Compressor Building
- 3,000-Watt wall mounted heater with wall mounted thermostat set at 80F.
- One 18-inch diameter, 120 volt, building ventilator with external thermostat set at 85F
- Two passive 8" X 10" wall vents (may require blockage during winter months)

Treatment Building
- Two 18-inch x 24-inch manual operated wall louvers.

16.5 Interior and Exterior Lighting

Normal system inspections and site work shall be conducted during daylight hours. In order to assure a safe work environment and provide sufficient lighting for site security. Both interior and exterior lighting has been installed on the buildings. The following is a listing of the lighting components used at the site:

Air Compressor Building
- Two dual 48-inch florescent interior light fixtures and wall switch

Treatment Building
- Eight Dual banks of 4-bulb fluorescent lights at the front entrance canopy.
- Eight 200 watt explosion-proof interior lights throughout the building.

16.6 Building Security

Both system buildings and all electrical panels shall remain locked AT ALL TIMES. Both the AC/ VA building and the treatment building are located within sight of the neighboring recycling operation. This property is isolated by a 6 feet high chain link fence, which remains locked at all times.

16.7 Floor Sumps and Recovered Liquid

The foundation of the treatment building contains a cast-in-place concrete containment sump. The sump is fitted with three level control probes to notify the operator of a "flooding" condition. The following is a list of general guidelines for inspection and removal of fluids from the floor sump. THIS IS NOT A STANDARD PROCEDURE. THE OPERATOR SHOULD CONFIRM ANY WORK SCOPE WITH A QUALIFIED HEALTH AND SAFETY OFFICER BEFORE PERFORMING ANY DUTIES.

Treatment Building Floor Sump 50 gallons

- NORMALLY DRY.
- Fitted with a Double Diaphragm sump pump to transfer recovered liquids to the S-1 Equalization tank.
- If a notable volume accumulates, inspect the concrete pad area around the K-1, K-2, S-1 tanks. Also inspect the air stripper system and water treatment system lines to confirm there is not a leak in any lines.
- If during any inspection, water is present to greater than ½ volume of the sump, use the DDP to manually drain the sump. Sump water is automatically piped to return water to the S-1 equalization tank.

END OF SECTION

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Electrical service to the *PLC system alone* is shut off at the LP-100 circuit breaker #9 which feeds the 120-volt transformer.

Electrical service to the *treatment system HVAC and lighting features* may be shut off at the individual circuit breakers #1, #3, #5 and #7 within PB-100.

The various disconnects are listed for the operator to be aware of the system isolation features. The operator must be aware of the affects of ceasing power or restoring power to any motor or control system.

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Both of the system buildings include heating, lighting and ventilation. Both buildings include wall and ceiling insulation, however, due to different processes and environments, the various buildings utilize different HVAC components. The following is a listing of the heating and ventilation components used at the site:

Air Compressor Building
- 3,000-Watt wall mounted heater with wall mounted thermostat set at 80F.
- One 18-inch diameter, 120 volt, building ventilator with external thermostat set at 85F
- Two passive 8" X 10" wall vents (may require blockage during winter months)

Treatment Building
- Two 18-inch x 24-inch manual operated wall louvers.

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Normal system inspections and site work shall be conducted during daylight hours. In order to assure a safe work environment and provide sufficient lighting for site security. Both interior and exterior lighting has been installed on the buildings. The following is a listing of the lighting components used at the site:

Air Compressor Building
- Two dual 48-inch florescent interior light fixtures and wall switch

Treatment Building
- Eight Dual banks of 4-bulb fluorescent lights at the front entrance canopy.
- Eight 200 watt explosion-proof interior lights throughout the building.

16.6 Building Security

Both system buildings and all electrical panels shall remain locked AT ALL TIMES. Both the AC/ VA building and the treatment building are located within sight of the neighboring recycling operation. This property is isolated by a 6 feet high chain link fence, which remains locked at all times.

16.7 Floor Sumps and Recovered Liquid

The foundation of the treatment building contains a cast-in-place concrete containment sump. The sump is fitted with three level control probes to notify the operator of a "flooding" condition. The following is a list of general guidelines for inspection and removal of fluids from the floor sump. THIS IS NOT A STANDARD PROCEDURE. THE OPERATOR SHOULD CONFIRM ANY WORK SCOPE WITH A QUALIFIED HEALTH AND SAFETY OFFICER BEFORE PERFORMING ANY DUTIES.

Treatment Building Floor Sump 50 gallons

- NORMALLY DRY.
- Fitted with a Double Diaphragm sump pump to transfer recovered liquids to the S-1 Equalization tank.
- If a notable volume accumulates, inspect the concrete pad area around the K-1, K-2, S-1 tanks. Also inspect the air stripper system and water treatment system lines to confirm there is not a leak in any lines.
- If during any inspection, water is present to greater than ½ volume of the sump, use the DDP to manually drain the sump. Sump water is automatically piped to return water to the S-1 equalization tank.

END OF SECTION

SECTION 17

SYSTEM MONITORING

17.1 Personnel Requirements

The EPA and IDEM authorize the operation of a wastewater treatment system. The EPA and IDEM approvals reserve the right to levy financial penalties for operational upsets either accidental or intentional. All personnel involved with the site operation and site work must be familiar with the physical and chemical hazards at the site and knowledgeable of his/her limitations.

17.2 Training and License Requirements

The following is a list of personnel training and licensing requirements for any site activities. This list is the minimum requirements for any site personnel. Additional requirements may be imposed by state and federal regulations.

General Requirements ALL SITE WORKERS

- OSHA 40 Hour HAZWOPER Training
- Three (3) days previous OSHA site training by an OSHA HAZWOPER Supervisor
- Medical monitoring and medical surveillance before entering the site
- Medical authorization to perform HAZWOPER work
- Site instruction on the chemical and physical hazards of the site and HASP briefing
- Site instruction of Versar health and safety policy
- Instructional training on Lock-Out/ Tag-Out procedures

OPERATOR Requirements

- IDEM Approved Waste Water Operators Training Course
- IDEM Class C (or greater) Waste Water Treatment Operators license
- Minimum of two years experience on industrial waste water systems

17.3 Start-Up Testing and Report

Upon start-up of the recovery and treatment system, both the recovery rate from each of the SVE trenches and the treatment rate through each of the treatment units will require adjustment. The system should be balanced to maintain system performance and efficiency. The pressures and flows through the system shall be carefully documented during the first hours of system start-up or during any restart period after the system has been offline for more than 7 consecutive days. These values should be used as a baseline for the continued operation of the system and to help judge mechanical performance.

On the second day following system startup, the system should be checked for operation and balancing. The vapor levels from the vapor trenches, the 24-hour average airflow rates, the system vacuums, the tank levels and the filter pressures should all be compared to measurements at start-up.

The operator is responsible for confirming all permit requirements along with state and local regulations. The operator shall continually compare all influent and/or effluent samples against past system performance and against the design parameters established in the IDEM discharge approval.

The following is a list of general procedures which shall be used for start-up:

PERFORM GENERAL SYSTEM CHECKS

1) Confirm power to the site.
2) Visually inspect the exterior of the T-2 influent and T-4 effluent tanks.
3) Confirm the T-2 aeration blower is operating.
4) Climb the operator inspection stairs and visually inspect the interior of the T-2 and T-4 tanks.
5) View the interior of the treatment building through the inspection window beneath the building overhang.
6) Confirm all motors through the MCC are turned OFF and locked out.
7) Enter the treatment building and the air compressor building to visually confirm the floor is dry, the air space is "clear" of vapors and the building heater and ventilation systems are operational.
8) Confirm water levels are a minimum within all tanks including the K-1 and K-2 moisture separators.
9) Manually empty and dry completely the fluids from the building floor sump. Beginning with a documented dry floor sump helps to provide an indicator of any possible leaks.
10) Confirm the location and operation of all pumps and motors.
11) Confirm the liquid GAC's have been hydrated for a minimum of 24 hours.
12) Confirm the size of the TSS socks within the four bag filter vessels.
13) Close the effluent isolation valves for all pumps and tag the valves closed.
14) Confirm the circuit breaker to the PLC is turn ON.
15) Confirm the ISAAC remote monitor unit is ON.
16) Through the PLC window, confirm power exists to the Panel View MMI unit.
17) Close the manual air supply valves to pneumatic Double Diaphragm dewatering pumps.
18) Confirm all condensation is drained from the air compressor tank.
19) Start the air compressor system and fill the compressor reservoir.
20) Confirm the air compressor particulate filter is functioning "in-the-green".
21) Open the compressed air line to the zero air generator on the FID unit.
22) Start the off-gas FID unit and confirm the last date of system calibration.
23) Calibrate the FID unit if required.
24) Confirm a sufficient supply of Hydrogen fuel for the FID unit.
25) Record the status of all liquid level switches through the Panel View.
26) Confirm the Leak Detection Sump level switch status.

BEGIN SVE SYSTEM OPERATION

27) Enter the treatment building and confirm the SVE vacuum pumps are clear and free of lockout protections.
28) Open extraction lines from a minimum of 10 extraction trenches.
29) Turn the circuit breaker for Vacuum Pump #1 ON.
30) Start Vacuum pump VP-1 through the Panel View.
31) Enter the SVE building and confirm VP-1 is running and creating a vacuum from the initial extraction trenches.
32) Allow VP-1 to operate for a minimum of 5 minutes while observing the system performance.
33) Confirm the water level in T-2 is above the low-level probe.
34) Turn the circuit breaker for the P-7 heat exchanger pump ON.
35) Start the P-7 heat exchanger pump through the Panel View.
36) Enter the building and open the P-7 flow control valves to the heat exchanger core. Flow rate from P-7 with only 10 SVE trenches open shall be approximately 1 to 1.5 gpm.
37) Visually observe flow is travelling through the heat exchanger and to the S-1 equalization tank.

38) Record the pressure readings and temperature readings on the P-7 water feed lines and the SVE airlines through the heat exchanger.
39) Turn the circuit breaker ON for the P-2, S-1 Equalization pump.
40) Start the P-2 equalization pump through the Panel View.
41) Confirm the Panel View is reading the following analog data and record the data:
   a) Air flow rate to the GAC units
   b) Air temperature to the GAC units
   c) SVE influent air concentration from the Vapor Analyzer
   d) Humidity readings to the GAC units
   e) GAC Bed #1 temperature
   f) GAC #1 effluent air quality from the Vapor Analyzer
   g) GAC Bed #2 temperature
   h) GAC #2 effluent air quality from the Vapor Analyzer
42) Enter the treatment building and observe the water level within the S-1 tank. If the water level in the S-1 tank will start the P-2 pump within 3 to 5 minutes, wait by the tank to visually confirm the P-2 pump will operate.
43) Open at least 5 additional SVE trench lines.
44) Turn the VP-2 Circuit breaker to ON.
45) Turn the VP-2 pump ON at the Panel View.
46) Enter the treatment building and confirm the VP-2 pump is running.
47) Record the vacuum readings, airflow readings, particulate filter readings and fresh air inlet settings for each vacuum pump.
48) Inspect the air temperatures across the Heat exchanger. If required, increase the water flow from P-7 to cool the SVE air temperature.
49) Allow the system to operate for a minimum period of 15 minutes. Simply observe the mechanical operation of the system and record all available readings.
50) Confirm the Vapor analyzer is operating correctly and "drawing" a sample into the unit.

BEGIN DEWATERING OPERATIONS

51) Confirm at least 1 suction valve on each of the 6 dewatering lines is OPEN.
52) Confirm the vacuum indicator switches are indicating NO vacuum on the dewatering lines.
53) Start the first DDP pump through the Panel View, typically DDP-1.
54) Enter the treatment building and confirm supplied air is reaching DDP-1. Confirm the air supply pressure is greater than 25 psi, but less than 50 psi.
55) Confirm the DDP is beginning to create suction on the influent line.
56) Wait at least 3 minutes and open a second suction line for the DDP.
57) Record the amount of time required to create a prime in the line, and for water to begin discharging to the S-1 tank.
58) Start the second DDP pump through the Panel View.
59) Continue steps 53, 54, 55 and 56 for the second DDP online.
60) Continue starting the remaining 4 DDP's through the Panel View and monitoring the start of each pump.
61) At this point the complete SVE system is operational.

STARTING THE WATER TREATMENT SYSTEM

62) Under most ALL conditions, the operator will arrive onsite and the SVE system will be operating. The operator will record all system readings and confirm the site operation.
63) The operator will inspect the tank level of T-2 and T-4 through the Panel View screen.
64) The operator must choose which Air Stripper feed pump and which GAC pump will be primary (P-100A or P-100B and P-1A or P-1B respectively) and set these pumps to primary through the Panel View screen.
65) The operator will confirm no high level conditions are occurring within the air stripper sump.

66) The operator will confirm or Open the flow control valves from the air stripper pumps to the GAC units.
67) Turn the P-1A and P-1B pump circuit breakers on at the MCC.
68) Start the P-1A and P-1B pumps at the Panel View.
69) If water remains within the sump of the air stripper, one of the P-1 pumps will begin operating.
70) The operator will confirm or Open the flow control valves from the T-2 influent tank to the air stripper feed pumps. Also open the flow control valves from the air stripper feed pumps to the air stripper inlet.
71) Turn the P-100A and P-100B circuit breaker on at the MCC.
72) Turn the air stripper blower motor circuit breaker on at the MCC.
73) Start the P-100A or P-100B pump at the Panel View.
74) At this point the air stripper blower should begin operation. The P-100 pump has a 30-second delay before the pumps start operating.
75) Record the pressure and flow readings to the air stripper.
76) Adjust the flow rate to the air stripper.
77) Observe the water level within the air stripper and confirm the P-1 pumps operate.
78) Record the pressure and flow readings to the GAC units.
79) Adjust the flow rate through the GAC units.

<u>START THE COMPLETE SYSTEM</u>

80) Approximately 6 hours should have passed at this point. Any leaks or problems should have been inspected. The flow meters and level indicators should have been inspected at least 3 times.
81) The only remaining pump motors not ON are the backwash pump, P-300 recirculation return pump and the P-200 final discharge water pump. Process sufficient water to fill T-4 to the 50% level and visually inspect the water quality within T-4.

IF THE OPERATOR IS CONCERNED REGARDING THE TREATMENT EFFICIENCY OF ANY UNIT, THE WATER WITHIN T-4 MAY BE MANUALLY REPUMPED FROM T-4 TO THE T-2 INFLUENT TANK USING THE P-300 RECIRCULATION PUMP.

IF THERE ARE ANY DOUBTS ABOUT THE TREATMENT EFFICIENCIES, A SAMPLE OF THE SYSTEM WATER SHOULD BE OBTAINED AND LABORATORY ANALYZED BEFORE DISCHARGING ANY WATER TO THE ROCKY RUN BROOK.

82) The final step is to turn the P-200 circuit breaker on at the MCC.
83) When ready to discharge, start the P-200 pump at the Panel View.
84) Documentation of all initial, a minimum of 8 hourly events, and the final site conditions on the first day of start-up is critical. This documentation will become the basis for all future system comparisons.

17.4 Site and System Monitoring

The system will require routine monitoring during the initial start-up period and then during long term system operation. The following are general guidelines for the system monitoring, with more frequent monitoring events required as determined by the operator.

Initial Start-Up
- Daily for 5 days
- Daily during all work days from Day 5 to Day 14 of the system operation.
- Four times weekly for weeks 3 and 4.
- Three times weekly for weeks 5, 6, 7 and 8.

Minimum of twice weekly for the first year of system operation

After a 7 days shut down period
Daily for 3 days
Four times weekly for the next week
Return to routine schedule

SYSTEM SAMPLING – VAPOR SYSTEM
Individual SVE Trenches – Laboratory Analysis
First week of System Start-up
Every other month
At least 4 clean "restart-spikes" to prove clean

Combined SVE Influent to the off-gas treatment

Combined "Middle" samples between off-gas treatment

Combined Final Air Discharge after treatment

SYSTEM SAMPLING – GROUNDWATER TREATMENT SYSTEM
Ground Water Treatment System sampling

Air Stripper Influent sampling	- Minimum of once per month
Air Stripper Effluent sampling	- Minimum of once per month
GAC Effluent sampling	- Minimum of once per month for first year
Final Effluent sampling –	- Min. of once per month & as directed by IDEM discharge approval

17.5 Routine Site and System Maintenance

The operator is responsible for system performance and system operation. Routine maintenance and mean-time-between-repairs (MTBR) can only be measured through operational history. The following is a listing of minimum repair and maintenance items that should be conducted by the operator. The operator must document at the site all procedures as they are performed and an exact description of the work completed.

Weekly Maintenance

- Inspect and change the TSS filter bags
- Inspect the oil level within the air compressor
- Monitor dewatering pumps
- Record all tank levels and note variations from the last visit
- Inspect recovery system to assure proper operation (i.e., alarm conditions, proper flow and pressures through system, clear discharge, piping leaks, shed lock integrity, blown fuses, light bulbs or control panel bulbs, pressure gauge accuracy's, etc.);
- Record monitoring data such as pressures through out the system.
- Decant water from the K-2 secondary knockout tank.
- Record comments on system operation and any work performed at the site;

Twice Monthly:

- Survey complete site to assure that site is secure;
- Backwash the primary GAC unit to T-2

Monthly

- Calibrate the Vapor Analyzer
- Obtain compliance samples as dictated by the IDEM discharge approval
- Inspect and drain air compressor receiver for condensate
- Visually confirm the accuracy of the level switches
- Inspect the outfall structure for debris or staining

Quarterly

- Change air compressor oil;
- Dead head all pumps to evaluate efficiencies
- Inspect the GAC pressure relief valves
- Check all high level floats

As Needed:

- Adjust flow rates;
- Clean probes;
- Replace Carbon from the primary bed
- Inspect electrical seals;
- Clean recovery pumps.
- Replace air compressor filter
- PLC reprogramming

END OF SECTION

SECTION 18

INITIAL AND ALARM SITE CONDITIONS

18.1 General Site Conditions

The recovery and treatment systems include several variables. The system is integrated with the various level, temperature and pressure monitoring instruments with the PLC to control the overall system operation. This section will provide the operator an item by item overview of various system components including historical levels at system start-up, "normal" system settings and "alarm" system settings.

PLEASE NOTE, ONLY A TRAINED AND LICENSED SYSTEM OPERATOR SHOULD START, ADJUST OR SHUT DOWN ANY SYSTEM COMPONENTS. THE FOLLOWING LIST OF CONDITIONS IS BASED UPON THE ORIGINAL SYSTEM SPECIFICATIONS AND SYSTEM PROVE-OUT. THE NORMAL OPERATING CONDITIONS MAY CHANGE AS THE REMEDIATION PROGRESSES.

18.2 Initial and Alarm Tank Conditions

The following is a list of the various process tanks including normal liquid levels and alarm levels. The operator should use this information to evaluate the site or reset site conditions in cases of a major power outage or system modification.

Tank Number	Low-Low	Low	High #1	High #2	High-High
T-2 Raw Water Influent Tank	38"	54"	124"	146"	158"
T-4 Effluent Water Tank	36"	54"	132"	N/A	156"
T-2 Leak Detection Sump	--	--	--	--	2" Above Tank Floor
T-4 Leak Detection Sump	--	--	--	--	2" Above Tank Floor
Air Stripper Level Switches	9"	11.5"	19"	22"	23.5"
	(Note these level settings cannot be adjusted)				
K-1 Primary Knockout Tank	N/A	12"	36"	N/A	42"
	(Note these level settings cannot be adjusted)				
K-2 Secondary Knockout Tank	N/A	12"	27"	N/A	31"
	(Note these level settings cannot be adjusted)				
S-1 Equalization Tank	N/A	12"	26"	N/A	30"
	(Note relative level settings cannot be adjusted)				
Floor Sump	N/A	6"	16"	N/A	20"

18.3 Initial Pump and Flow Conditions

The following is a list of the various flow rates for the recovery and process pumps. The operator should use this information to evaluate the site or reset site conditions in cases of a major power surge or power outage.

ELECTRIC PROCESS PUMP SCHEDULE

Pump Number	Normal Flow Rate (gpm)	Pump Pressure (psi)	Comment
P-1	5 gpm	15 psi	K-1 Transfer Pump
P-2	35 gpm	25 psi	S-1 Transfer Pump
P-7	4 gpm	18 psi	Heat Exchanger Feed Pump
P-100 A	35 gpm	40 psi	Air Stripper Feed Pump A
P-100 B	35 gpm	40 psi	Air Stripper Feed Pump B
P-1A	40 gpm	45 psi	GAC Feed Pump A
P-1B	40 gpm	45 psi	GAC Feed Pump B
P-200	75 gpm	20 psi	Final Effluent Pump
P-300	65 gpm	25 psi	Recirculation Pump
Backwash	60 gpm	80 psi	Manual Backwash Pump

PNEUMATIC PUMP SCHEDULE

Pump Number	Normal Flow Rate (gpm)	Normal Air Supply Pressure	Estimated Needle Valve Setting	Manifold Vacuum (in Hg)
DDP-1	2 gpm	35 psi	35%	12" Hg
DDP-2	3 gpm	40 psi	45%	13" Hg
DDP-3	3 gpm	40 psi	45%	13" Hg
DDP-4	2 gpm	35 psi	35%	12" Hg
DDP-5	2 gpm	35 psi	40%	13" Hg
DDP-6	2 gpm	40 psi	25%	14" Hg
DDP-7 Building Floor Sump Pump	15 gpm	40 psi	50%	1" Hg

18.4 SVE Process Conditions

The following is a list of the various process and flow conditions for the SVE system. The operator should use this information to evaluate the site or reset site conditions in cases of a system shutdown.

Monitoring Point	Normal Vacuum Pressure Level (" Hg)	Normal Air Flow Rate (scfm)	Normal Air Temp (Deg F)	Alarm Condition
Indiv. Native SVE Trenches	8 to 10 "Hg	25 to 40 scfm	55 to 80	None
VP-1 Vacuum Pump	5" Hg Alone 10" Hg in Tandem	1,100 scfm	175 F Discharge	High Discharge Temp @ 225 F
VP-2 Vacuum Pump	5" Hg Alone 10" Hg in Tandem	1,100 scfm	175 F Discharge	High Discharge Temp @ 225 F
Combined SVE To Heat Exchanger	<1.5" Hg Pressure	2,200 scfm	175 F Discharge	None
Combined SVE After Heat Exch.	<1.5" Hg Pressure	2,200 scfm	110 to 125 F Discharge	High Temp @ 135 F
Combined Vapor To GAC #1	<1.5" Hg Pressure	2,200 to 3,400 scfm	100 to 120 F	High T @ 135 F Hi Humid >70% RH
Combined Vapor To GAC #2	<1" Hg Pressure	2,200 to 3,400 scfm	110 to 120 F	High T @ 135 F
Combined Vapor Effluent	<0.2" Hg Pressure	2,200 to 3,400 scfm	115 to 125 F	High T @ 135 F

The following is a list of the various process instrumentation settings for the process system. The operator should use this information to evaluate the site or reset site conditions in cases of a system shutdown.

PROCESS SYSTEM INSTRUMENTATION SETTINGS

Monitoring Point	Normal Process Condition	Alarm Process Condition	Comments
SVE Air Temperature	110 to 125 Deg F	High Temp @ 135 F	OPERATOR Set Condition through the Panel View
Total Air Temp to GAC's	80 to 120 Deg F	High Temp @ 135 F	OPERATOR Set Condition through the Panel View
Air Humidity To GAC's	40 to 55 % RH	High Humidity @ 70% RH	OPERATOR Set Condition through the Panel View
Vapor Content To GAC's	50 to 300 ppm as C3H8	Flow Dependent	OPERATOR Set Condition through the Panel View
GAC #1 Bed Temp	100 to 120 Deg F	High Temp @ 135 F	OPERATOR Set Condition through the Panel View
GAC #1 Vapor Effluent	15 to 150 ppm as C3H8	Flow Dependent	OPERATOR Set Condition through the Panel View
GAC #2 Bed Temp	110 to 120 Deg F	High Temp @ 135 F	OPERATOR Set Condition through the Panel View
Vapor System Effluent	0 to 75 ppm as C3H8	Flow Dependent	OPERATOR Set Condition through the Panel View

18.5 Alarm Notification and Reporting

The operator is responsible for reporting any treatment excursion to Handex and Versar within 2 hours of identification or confirmation of the excursion. The operator must be knowledgeable of the system and the site operation.

Local (level) alarms are indicated at the Panel View screen with "critical" alarms reported to the RMU. The operator must record all of these conditions and be familiar with the site. If a "nuisance" alarm continues to occur due to programming errors, the operator should have the program modified. In no case should an alarm condition continue to occur for more than 3 occurrences in any 7 days period without notification.

END OF SECTION

SECTION 19

OPERATIONAL SAFETY FEATURES

19.1 General Overview

The operation of the recovery and treatment systems may be dangerous to untrained or unauthorized personnel. The operator must be fully aware of all system components as well as the operation of individual components and the interaction of the component with other system equipment.

This Operations and Maintenance Manual is being prepared as a record of the system design, normal system operation and an over view of the system components. This manual is not designed as a training manual and should only be used by a trained licensed wastewater treatment operator to compliment previous training and work experience.

No system adjustments should be made without reviewing the original system design and performance specifications. Similarly, only a trained electrician should make any electrical adjustments or modifications to the system.

19.2 Treatment Enclosure

The two treatment enclosures have been designed for their individual purposes. The treatment building is a pre-fabricated steel building. The interior of the treatment building has been classified as a Class 1, Division 1, Group D explosive environment as defined by the National Electrical Code. All interior wiring and controls have been isolated and sealed to prevent any potential for an open spark.

The air compressor and vapor analyzer building is considered unclassified. The electrical wiring and controls have been protected within conduits, however the electrical motors and wiring are not contained. Vapors of any type should never be identified within the air compressor building.

19.3 Emergency High Level Floats

All pump and system operations are controlled through the PLC and various level switches. As a safety feature, Emergency High level floats have been installed within the tanks to confirm the system will cease operation should an operator switch be set incorrectly OR the operator mistakenly forgets to start a pump system. The following is a list of the digital level floats that provide a redundant safety feature to the system:

- T-2 Hi-Hi — High-High Level Float at 20-inches from top of tank
- T-4 Hi-Hi — High-High Level Float at 18-inches from top of tank
- K-1 Hi-Hi — High-High Level Float at 38-inches from top of tank
- K-2 Hi-Hi — High-High Level Float at 29-inches from top of tank
- S-1 Hi-Hi — High-High Level Float at 14-inches from top of tank
- Floor Sump Hi — Set at 4-inches below finished floor

19.4 Building Floor Sump

A cast-in-place concrete leak containment sump has been cast within the building foundation. The sump has a capacity of 50 gallons. The sump is covered with PVC grating that is rated for 600 pounds of load.

The floor sump provides a low drainage point for collection and removal of miscellaneous wash down water, minor process leaks or backwash water that escapes. The sump is visible from the exterior of the building by looking through the operator window near the PLC. Because of the potential hazard of electricity and water, the operator should not enter the building with free standing water on the floor or overflooding the sump without de-energizing the system electrical supply.

19.5 GAC Pressure Rating

The P-1A and P-1B, GAC feed pumps are relatively high head pumps. Each pump is capable of pressures of 90 psi during flowing operations. The manual operation backwash pump is capable of pressures to 115 psi.

The GAC filter vessels are ASME Code pressure rated for 150-psi constant duty and pressure tested at 180 psi prior to shipment.

19.6 GAC Pressure Relief Valve

Each of the GAC's influent lines is equipped with brass pressure relief valves. Both relief valves are pre-set at 85 psi. Should a high-pressure condition occur within the GAC's, the pressure relief valves will route water from the inlet of the GAC's to the floor sump.

19.7 Compressed Air Regulators

The air compressor provides compressed air to the DDP dewatering pumps; the building floor sump DDP, the K-1 air operated valve, the FID unit and two maintenance air stations within the treatment building. Dial indicating hand adjustable air pressure regulators are provided at each of the air locations. No air regulator should be set higher than 80 psi at any time.

19.8 Compressed Air Relief Valve

The air compressor and storage receiver were provided as a package from LeRoi Compressors. The compressor receiver includes an integral spring-loaded pressure relief valve. The relief valve is mounted on the side of the receiver and is factory set at approximately 150 psi.

19.9 Storage Tank Secondary Containment Liners

The T-2 influent and T-4 effluent tanks have been constructed onsite with a steel outer support ring and internal liners. The tanks include two completely redundant liners with the interior liner providing primary containment. The secondary liner provides >100% leak containment.

Included within the annular space of the two liners is a leak detection drain. The leak detection drain removes water from between the two liners and funnels this water to 12-inch leak detection sumps located next to the tanks. Level control probes are deployed within the leak detection sumps. Should fluids begin to accumulate within the leak detection sumps, the leak detection probe will signal the PLC system to alarm the operator.

19.10 Electrical Disconnects

The electrical service to the system is supplied by a dedicated 3 phase electrical service. All electrical service to the system and various system components may be shut down at the following disconnect locations:

Electrical service to the *entire system including the treatment system and the air compressor building* may be shut at two different locations:

1. The 600 amp, 480-volt knife-switch mounted near the entrance to the property, adjacent the electrical meter beneath the onsite utility poles.
2. Also at the PB-100 main 480-volt electrical control panel, by closing the 600 amp main breaker.

Electrical service to the *air compressor* may be shut off at two locations:

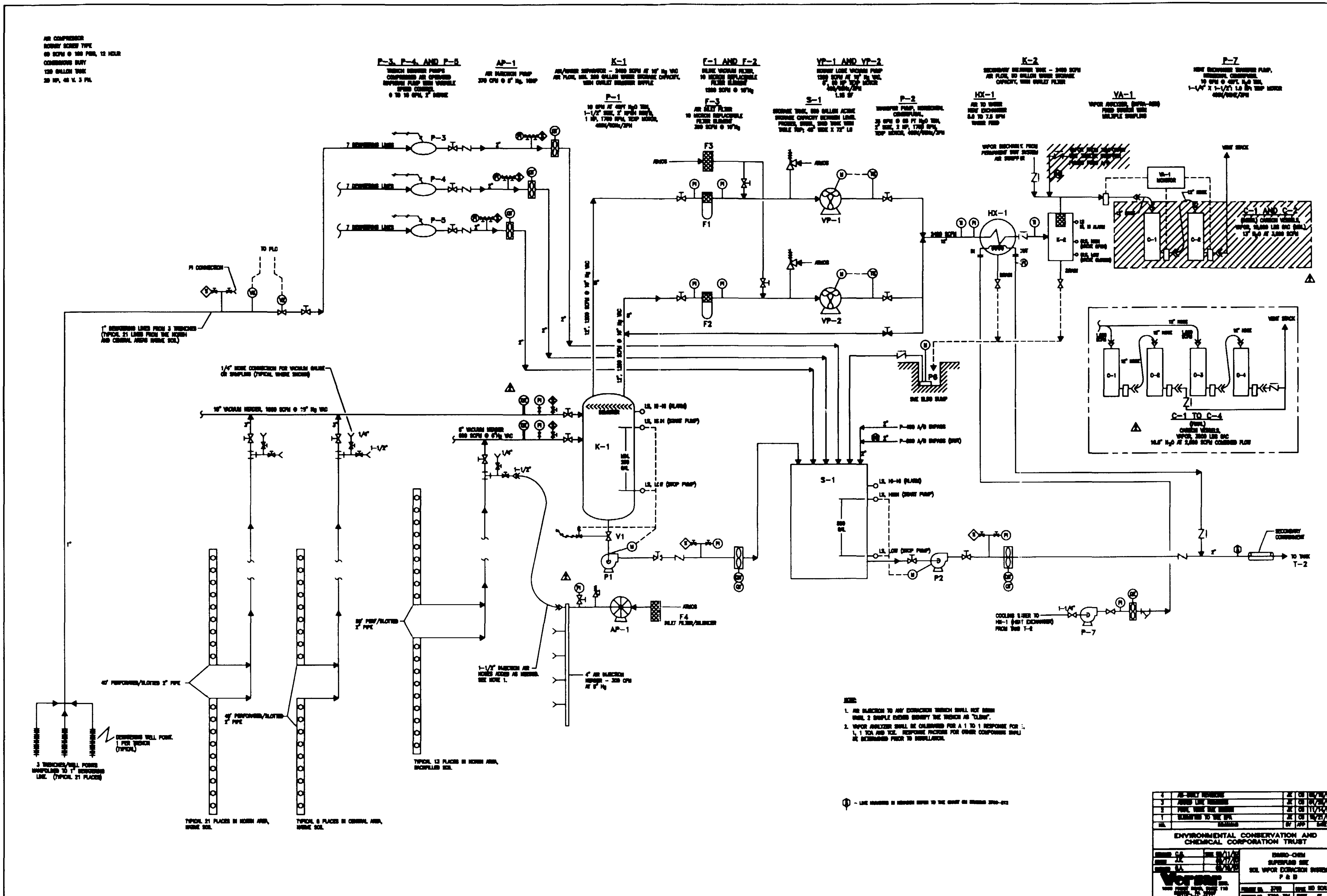
1. The PB-100 electrical control panel, by closing the 40-amp 460 volt 3 phase breaker at position 1A.
2. The knife-switch disconnect mounted on the air compressor adjacent to the air compressor integral control panel.

Electrical service to the *PLC system and associated instrumentation* may be shut off at the LP-100 circuit breaker #14, #16, #18 and #20. These 4 breakers all feed the PLC system and associated instrumentation.

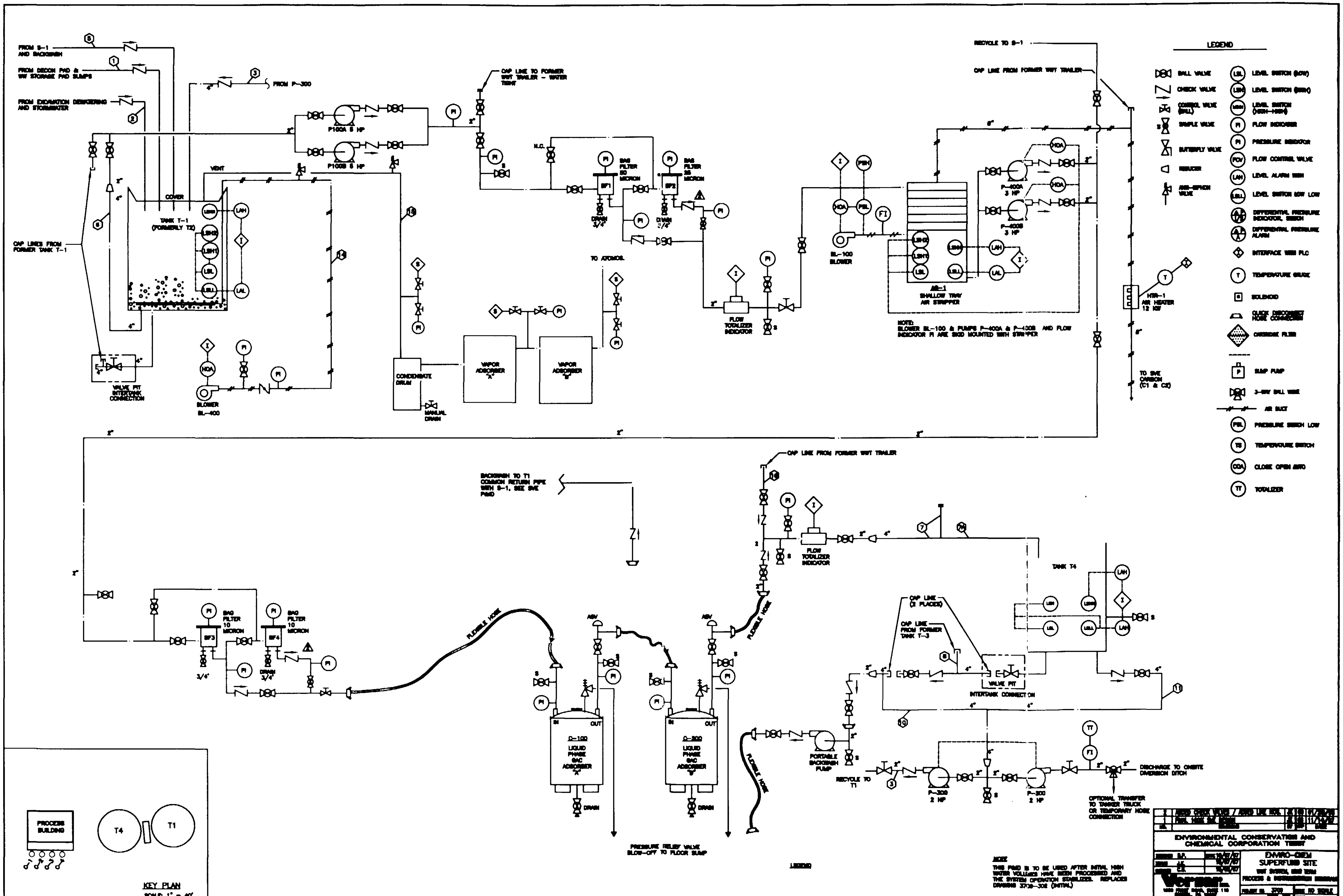
Electrical service to the *PLC system (alone)* is shut off at the LP-100 circuit breaker #9 which feeds the 120-volt transformer.

Electrical service to the *treatment system HVAC and lighting features* may be shut off at the individual circuit breakers #1, #3, #5 and #7 within PB-100.

END OF SECTION



P-3, P-4, AND P-5
AP-1
K-1
F-1 AND F-2
VP-1 AND VP-2
K-2
P-7
P-1
F-3
S-1
P-2
HX-1
VA-1
C-1 AND C-2
C-1 TO C-4
P-3
P-4
P-5
F3
F1
F2
VP-1
VP-2
HX-1
K-1
V1
P1
S-1
P2
P-7
AP-1
F4
P6
TO PLC
TO TANK
T-2
ENVIRONMENTAL CONSERVATION AND
CHEMICAL CORPORATION TRUST
P & ID
NO SCALE


LEGEND
BALL VALVE
CHECK VALVE
SAMPLE VALVE
BUTTERFLY VALVE
REDUCER
LEVEL SWITCH (LOW)
LEVEL SWITCH (HIGH)
FLOW INDICATOR
PRESSURE INDICATOR
FLOW CONTROL VALVE
LEVEL ALARM HIGH
LEVEL SWITCH LOW LOW
DIFFERENTIAL PRESSURE INDICATOR, SWITCH
DIFFERENTIAL PRESSURE ALARM
INTERFACE WITH PLC
TEMPERATURE GAUGE
SOLENOID
SUMP PUMP
3-WAY BALL VALVE
AIR DUCT
PRESSURE SWITCH LOW
TEMPERATURE SWITCH
CLOSE OPEN AUTO
TOTALIZER
FROM S-1 AND BACKWASH
FROM DECON PAD & WW STORAGE PAD SUMPS
FROM EXCAVATION DEWATERING AND STORMWATER
FROM P-300
CAP LINES FROM FORMER TANK T-1
TANK T-1 (FORMERLY T2)
COVER
VENT
VALVE PIT INTERTANK CONNECTION
BLOWER BL-400
P100A 5 HP
P100B 5 HP
CAP LINE TO FORMER WWT TRAILER - WATER TIGHT
N.C.
BAG FILTER 50 MICRON
BAG FILTER 25 MICRON
DRAIN 3/4"
TO ATMOS.
CONDENSATE DRUM
MANUAL DRAIN
VAPOR ADSORBER "A"
VAPOR ADSORBER "B"
FLOW TOTALIZER INDICATOR
BL-100 BLOWER
AS-1 SHALLOW TRAY AIR STRIPPER
P-400A 3 HP
P-400B 3 HP
NOTE: BLOWER BL-100 & PUMPS P-400A & P-400B AND FLOW INDICATOR FI ARE SKID MOUNTED WITH STRIPPER
RECYCLE TO S-1
CAP LINE FROM FORMER WWT TRAILER
HTR-1 AIR HEATER 12 KW
TO SVE CARBON (C1 & C2)
BACKWASH TO T1 COMMON RETURN PIPE WITH S-1, SEE SVE P&ID
CAP LINE FROM FORMER WWT TRAILER
BAG FILTER 10 MICRON
FLEXIBLE HOSE
ARV
D-100 LIQUID PHASE GAC ADSORBER "A"
D-200 LIQUID PHASE GAC ADSORBER "B"
DRAIN
PRESSURE RELIEF VALVE BLOW-OFF TO FLOOR SUMP
TANK T4
CAP LINE (2 PLACES)
CAP LINE FROM FORMER TANK T-3
VALVE PIT
INTERTANK CONNECTION
PORTABLE BACKWASH PUMP
RECYCLE TO T1
P-300 2 HP
P-200 2 HP
DISCHARGE TO ONSITE DIVERSION DITCH
OPTIONAL TRANSFER TO TANKER TRUCK OR TEMPORARY HOSE CONNECTION
PROCESS BUILDING
T4
T1
KEY PLAN
SCALE: 1" = 40'
LEGEND
NOTE
THIS P&ID IS TO BE USED AFTER INITIAL HIGH WATER VOLUMES HAVE BEEN PROCESSED AND THE SYSTEM OPERATION STABILIZED. REPLACES DRAWING 3739-302 (INITIAL)
ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION TRUST
ENVIRO-CHEM SUPERFUND SITE
PROCESS & INSTRUMENTATION DIAGRAM
NO SCALE